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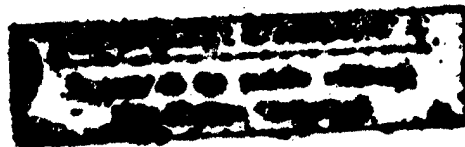
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# USSR Report

LIFE SCIENCES

BIOMEDICAL AND BEHAVIORAL SCIENCES

No. 30



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11 March 1983

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LIFE SCIENCES  
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## AEROSPACE MEDICINE

### PSYCHOLOGICAL COMPATIBILITY OF COMBAT FLIGHT CREWS

Moscow AVIATSIYA I KOSMONAVTIKA in Russian No 12, Dec 82 pp 30-31

[Interview with USSR Honored Combat Navigator Colonel N. Glazunov by AVIATSIYA I KOSMONAVTIKA correspondent Colonel E. Besschetnov: "Flight and Psychology. Psychological Compatibility of the Crew"; date and place not specified]

[Text] A new training year has begun in the units and subdivisions of the Supreme War Council. Aviators are presented complex and responsible tasks of further increasing vigilance and combat readiness and improving fighting skills. Their successful solution depends upon many factors, including correct, scientifically-based manning of flight crews.

AVIATSIYA I KOSMONAVTIKA correspondent Colonel E. Besschetnov requested USSR Honored Combat Navigator Colonel N. Glazunov to answer questions related to the specifics of the staffing of crews of multi-seated combat airplanes.

[Besschetnov] There exists the concept of "psychological compatibility". In what, in your view Nikolay Lavrovich, does it consist with regard to the crews of long-range bombers?

[Glazunov] The crews of our airplanes are frequently in autonomous flight for several hours running, and much longer during in-flight refueling of the airplanes. The aviators experience huge physical and psychological loads and, of course, get tired. On this soil there can arise irritability, impatience and even mistakes. How important it is to be able to resist the difficulties, to be on good terms with one another, to render timely mutual support and assistance, to spare the nerves and feelings of one's colleagues! This is possible primarily on condition that the crew contains people whose professional and personal qualities meet the high demands of modern combat and yield the best combination necessary for fruitful work in any, extremely complex situation. It is very important here, and I might say essential, that each crew member thoroughly understands the tasks before the group and directs all his efforts at their precise and unconditional solution. Here, perhaps, is the essence of psychological compatibility. Its indispensable components are high cohesion of the flight crew, mutual understanding among its members and, of course, a low level of conflict. If this can be attained, one can be assured that success is guaranteed.

As an example there may serve the excellent crew of the communist squadron commander, Major Krasil'nikov, who has long had a high overall rating. Krasil'nikov is a first-class combat pilot and also a first-class ship navigator. The ship-commander's assistant, the second navigator and the other aviators also have rather good training. They prepare for flights conscientiously and perform tasks with high quality. An important role in this is played by the firm combat cohesion of the crew members, the ability to understand and support one another at a difficult moment.

I recall such an incident. After a flight of many hours to the range, the crew was returning to the aerodrome. A strong head wind at flight altitude introduced corrections to the computed data: when the bomber approached the "point", the fuel remaining precluded a second approach to the landing. And the weather conditions were complex. Allow a miscalculation with the approach onto the aerodrome and it cannot be corrected. It would seem that the crew had serious bases for anxiety and nervousness. But nothing of the sort was observed. Major Krasil'nikov and the ship navigator Captain Skorikov correctly evaluated the situation, rapidly performed additional calculations and confirmed their actions with the command point. Their calmness and self-possession were transmitted to the other crew members. Each performed his duties precisely and with assurance. The flight was completed successfully.

The ship commander and his navigator have worked together for five years; the other crew members have been together for hardly less time. This time, speaking frankly, is not short if one considers the usual transfers of people through the service. Complete mutual understanding is observed between crew members; healthy moral relationships have been established. The tone in everything is set by Major Krasil'nikov, an exacting and strict, but just man. As the commander he is concerned that the subordinates respect one another, do not permit coarseness or tactlessness. He knows how to cut short a developing conflict, to resolve an argument or disagreement without an unnecessary flareup of emotions.

Most of our crews are equally cohesive and harmonious. Their experience once more confirms an indisputable truth: for successful work it is not sufficient that the people possess only good individual training. No less important is that they know how to work with one another in a combat group, that their professional and personal qualities yield an optimal combination for the attainment of a single purpose.

Modern multi-seated airplanes are highly complex systems, and overall success is in great degree dependent upon each crew member. Therefore, it is important to take care that the best combination of qualitative characteristics of the crew members is assured, that harmony is achieved in their interrelationships, that they make a stable group capable of successfully solving the problems at hand.

[Besschetnov] On the basis of your own experience, what can you say about the specifics of crew manning for multi-seated airplanes taking into account psychological compatibility?

[Glazunov] The question is not simple. As is known, there are as many unique, non-repetitive characters as there are people. And each person in any instance requires a particular approach, the more so during crew manning, when one must not only forecast the probable interrelationships but also anticipate the likely directions of their development.

The commanders, political workers, deputy commanders, and chiefs of staff of the units and subdivisions, the unit navigator and others usually participate in all types of transfers of people and the staffing of new crews. As a rule, the responsible persons proceed from the fact that the interrelationships in newly created "closed" groups are a matter that is very subtle, delicate and deeply affects the interests and feelings of people. Especially needed here are a sensitivity to each person, a thoughtful approach to the solution of this question and a comprehensive consideration of its psychological, moral and professional qualities. In the selection of people for a crew we take into consideration the education of one or another pilot or navigator, his class level, the length of flight work and, also, the moral-political and psychological training and character makeup.

I remember when we received young reinforcements: pilots and navigators, recent graduates of the combat aviation schools. How were we to distribute them among the crews? First of all, to solve this question, the commander, his deputy for political affairs, the senior navigator and staff officers acquainted themselves with the personal file of each, giving special attention to the contents of the graduation attestations. Then they talked with each young officer, determining the level of knowledge, individual tendencies, interests and aspirations. With everyone gathered together they exchanged opinions. This assisted in arriving at a clearer understanding of each of the arrivals, their possibilities, level of training and character traits. They talked also with the commanders and navigators of the ships in whose crews the reinforcements were to be sent and determined their wishes. On this basis, the young officers were incorporated into the crews. Intensive training was begun. And it must be noted that most of the novices successfully improved their combat skills without disruptions. Most of them became excellent pupils.

Usually we form crews according to the principle: a young navigator we assign to a trained ship commander. Such an approach to the matter is more warranted in that it requires less expenditure of effort and time for guaranteeing high combat readiness. In fact, a crew headed by an experienced, comprehensively-trained commander makes flights day and night, under simple and complex weather conditions for flying planes and for combat application. Favorable conditions are created for the ship navigator to attain the necessary level of training. Practice shows that, as a rule, he requires only several months to be completely "enlisted" in the crew.

In some cases we man a totally young crew. True, this extends to some degree on the aviator-training time. To reduce it somewhat, we attempt to select a sufficiently experienced assistant for the ship commander and a knowledgeable second navigator for the young navigator. This is what we did, for example, in selecting the crew that is now headed by Captain Nesterenko. Neither the

ship commander, assigned to his present duty before the start of the past training year, not his navigator Captain Volkov, promoted at the same time, possessed the necessary experience. In order to strengthen the crew we incorporated in it as second navigator Senior Lieutenant Il'minskiy, who had flown more than one year on a bomber of this type and possessed good training. In accordance with the combat-training program, the crew trained separately day and night for combat. The people acquitted themselves well. The group proved to be completely cohesive and efficient. It was not necessary to change its composition, and it was maintained. Now the aviators are training for action in group combat formations. If at the end of the year any problems are found in the work of the crew or misunderstandings in interrelationships, the command, as has sometimes happened, will have to make the necessary transfers.

Sometimes life demands recourse to a different principle: the ship commander is young and the navigator is trained. Thus, Captain Mayunov, who by this time had the first class rating, was assigned as ship navigator to Captain Merkulov, a second-class pilot. This makeup, frankly speaking, was involuntary. For what happens? The ship commander begins to learn sequentially the training program and only later moves on to perform flights for combat application. The navigator, thus, for an extended time flies "at idle", essentially uninvolved in combat application, and as a result partially loses his training. It is not excluded that he, not having accumulated the necessary flying time in combat application under complex conditions day and night, might not confirm the first class.

As we see, crew manning is not any mechanical transfer of people: this one there, that one here; but it is a complex multifaceted process, requiring consideration not only of the individual characteristics of people but also the diverse factors associated with guaranteeing a high combat readiness and the effective training and education of air fighters, with the strengthening of order and organization in the group.

It should be stated that we do not always succeed in satisfactorily dealing with this. There are disappointing mistakes. The composition of certain crews must be changed for various reasons, including psychological incompatibility.

[Besschetnov] Nevertheless, a crew is staffed. What, in your opinion, is required from the point of view of psychological compatibility so that the crew be distinguished by cohesion, a high degree of harmony and combat readiness?

[Glazunov] Observations show that the "adjustment" of temperaments frequently follows definite rules. In some instances people fully adjust to various temperaments. Indicative in this respect is the interaction of ship commander Captain Trubnikov, a calm, unruffled, even excessively easy-going man, and the second navigator Senior Lieutenant Druzhinin, by nature quick and lively. During flight they, in effect, mutually complement one another. Whereas Trubnikov's deliberateness in actions restrains the combat assistant from hurried actions, Druzhinin's rapidity and drive during work does not allow

the ship commander to delay the matter of making a decision or performing the necessary calculations. As a result, their mutual influence yields good results. The crew has a high rating in air navigation and bombing.

To evaluate fully the emotional-volitional qualities of one or another pilot or navigator is complicated. People are encountered whose character is distinguished by negative traits, say, irascibility, a lack of steadiness. It would seem that you know the man and everything is clear. But this is not so. One can contain himself at the necessary moment, by an effort of will suppress rising emotions, force himself to act cold-bloodedly; while another under identical conditions and with the same character traits loses self-control, allows haste and nervousness, makes an unforgivable mistake. It is hard to foresee how a man will behave in a complicated situation. One must have experience and understand well the psychology of people in order to forestall negative events. It is important that the ship commander and his assistant and the ship navigator and second navigator, being different in character, mutually complement one another.

Practice shows it is expedient that the composition of a successfully selected crew be retained for the longest time possible. Clearly, no little time is required for the crew members to work well together, to "get used" to one another. And, harmony in their actions appreciably influences the maintenance in the crew of the moral-psychological atmosphere necessary for successful work.

Psychological compatibility is higher in those crews where the people are distinguished by political consciousness and ideological assurance and strive to perform their duty irreproachably. In carrying out educative work, we direct special attention to the development of these qualities in air fighters. Clearly, ideological affinity, the aspiration for the same moral and esthetic values, brings people together. This is due primarily to the fact that group or collective efforts of people are aimed at solving not private but common, large-scale tasks, which require the subordination of personal interests to the interests of the group.

In concerning themselves with guaranteeing psychological compatibility in flight crews, the commanders and political workers consider this and systematically foster collectivist qualities in the aviators. Much attention is given to their development of habits for precise joint actions, especially in the process of the combat application of aviation technology.

The creation of a positive psychological climate in the group and the attainment of successes in combat training and service depend in many ways upon the commanders, their ability to work with people and to structure correctly interrelationships with them. A commander's fussiness or impatience, his insecurity in making a decision negatively affect his authority. Therefore, provision of a high psychological compatibility in flight crews cannot be successful without persistent systematic work with the commanders to elevate their pedagogic skills.

[Besschetnov] In conclusion Colonel N. Glazunov said:

[Glazunov] Harmony in the actions of flight crews, their cohesion, thorough understanding by each of his assignments are an important prerequisite for attaining high results in the improvement of combat skills. Advanced experience must be more fully utilized for the creation in the group of a business-like atmosphere, of a situation of high efficiency.

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## BIOCHEMISTRY

UDC 595.764.1:591.551

### SEX PHEROMONE IN ANOXIA PILOSA (COLEOPTERA, SCARABAEIDAE)

Moscow ZOOLOGICHESKIY ZHURNAL in Russian Vol 61, No 9, Sep 82  
(manuscript received 9 Mar 81) pp 1434-1436

IVASHCHENKO, I. I., Krasnodar Experimental Field Station

[Abstract] Studies were conducted to clarify earlier work on the role of pheromones in regulating behavior and sexual activity in Scarabaeidae. The subject chosen was *Anoxia pilosa* F. (hairy may beetle), an agricultural pest widely distributed throughout the Ukraine, Caucasia and Transcaucasia. Beetles were collected from depths of 25-30 cm. in the soil and separated by sex for further investigation. Insects grown from cocoons under laboratory conditions were also used. In the laboratory, attraction was determined in males to virgin females. For experimental purposes the bodies of the females were arbitrarily divided into three parts (head, thorax, abdomen) to determine the source of pheromone production. In the field, lures containing males, females and controls (empty lures) in sequence (1 individual per lure) were set at distances of 50 meters from each other and the numbers of visitors counted. Lures containing virgin females were visited by 70-168 males in a 24-hour period. In the laboratory, attraction was established by presenting males with females, prepared parts of the female body, or the filter paper on which they had been. Attraction for the males depended on the physiologic status; first signs of sexual activity appeared 2-3 days following imago emergence. After copulation, females ceased to produce sex pheromone. Males displayed no sexual interest for 2-3 days after copulation. Virgin females began to produce sex pheromone toward the end of the day, simultaneously assuming the mating pose; this activity declined after 2.-2.5 hours. The pheromone-producing organ is located in the abdomen of the female, demonstrated by an overwhelming male preference for this part of the body in preference to the head or thorax. The pheromone produced by the female *Anoxia pilosa* is highly species-specific. References 11: 3 Russian, 8 Western.  
[123-9642]

ENVIRONMENT

UDC 577.472(541.124):628.35

MODEL OF ADAPTATION OF ACTIVATED SLUDGE ECOSYSTEM TO MULTI-COMPONENT POLLUTANT

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, Dec 82  
(manuscript received 7 Jun 82) pp 1012-1016

VAVILIN, V. A. and VASIL'YEV, V. B., Institute of Water Problems, USSR Academy  
of Sciences, Moscow

[Abstract] Mathematical evaluation was performed of the alterations in the bacterial flora of activated sludge when exposed to difficult-to-oxidize multicomponent pollutants. The results showed that step-wise re-exposure of the sludge results in predominance of flora most efficient in oxidizing the given pollutants, and that by such means the efficiency of biological treatment can be improved. Figures 4; references 4: 3 Russian, 1 Western.  
[126-12172]



## MIGRATION OF CLETHRIONOMYS GLARELUS WITHIN HOME RANGE AND BEYOND

Moscow ZOOLOGICHESKIY ZHURNAL in Russian Vol 61 No 9, Sep 82 (manuscript received 7 Jul 81) pp 1413-1418

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[Abstract] Studies were conducted to clarify the features of movement within the home range and beyond in *Clethrionomys glareolus* as part of the problem of the spatial organization of populations. Field observations were conducted during the period 1969-1977 in a predominantly oak wooded-steep area in Belgorod Oblast, using labeled animals under natural conditions. Visual observation was adequate to follow the movements of individuals across the one hectare area of observation that was mapped on a scale of 1:100 to show all dead trees, stumps and other natural features such as open grassy areas and the relief of the ground. During the period of observation more than 500 individuals were observed in about 2,000 visual observations. Material on the movement of animals outside the home range was gathered from adult individuals only. It was established that movement within the home range is effected along well-defined paths marked by definite reference points such as tree stumps. Familiarity with paths enabled individuals to move at rates of 0.5-3.0 meters per second across open ground between reference points. Females tended to spend more time in the foraging area. Adult females made "dashes" of 3-5 meters between points of cover; adult males made "dashes" of 50-100 meters. Traffic on given routes was determined by the nest location and foraging sites. Comparison of the data obtained with data from observations of other small mammals indicated that, at least among rodents, a general principle exists in the organization of methods of movement within the home range. Movement outside the home range was caustious, with individuals remaining at first within 2-3 meters of known territory. In most cases movement into territory outside the home range was made in radial excursions whose distances were gradually increased up to about 100 meters. Subsequent homing was rapid and good from distances up to about 50 meters. Homing time from a given point did not decrease with practice; individuals tended to follow the same homeward route as that taken on the outward excursion unless pursued by any other territory holder, usually confined to a few meters, was prolonged, forcing the experimental subject to alter its route. References 20:

9 Russian, 11 Western.

[123-9642]

CLETHRIONOMYS RUTILUS (CRICETIDAE, RODENTIA) AS VECTOR FOR EPIDEMIC HEMORRHAGIC FEVER VIRUS

Moscow ZOOLOGICHESKIY ZHURNAL in Russian Vol 61, No 9, Sep 82  
(manuscript received 13 Apr 81) pp 1444-1446

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[Abstract] In addition to *Apodemus agrarius* in the Far East and *Clethrionomys glareolus* in the European parts of the USSR, as known vectors of epidemic hemorrhagic fever (hemorrhagic fever with renal syndrome) virus, researchers have also suspected that the red-backed vole *Clethrionomys rutilus* plays a role in the spread of this disease. However, although it is frequently encountered at sites of epidemic hemorrhagic fever in the southern taiga of the European part of the USSR, no direct epidemiologic or laboratory proof of its involvement had ever been adduced. Observations were conducted in southern Udmurtiya over four epidemic seasons (1973, 1974, 1976 and 1979). *Clethrionomys rutilus* made up 2.0% 6.2% of a total of 12,700 animals trapped during these observations. In 1979 during two separate outbreaks of epidemic hemorrhagic fever in Kenskiy Forest, southeast of Izhevsk, and on islands in the Alnash Rayon involving 6 and 10 cases respectively, the numbers of *Clethrionomys rutilus* were much greater (35% of the total animals trapped). In epidemiologic studies done on lung sections using the indirect immunofluorescent antibody reaction, epidemic hemorrhagic fever viral antigen was found in 7 of 32 specimens of *Clethrionomys rutilus* (and 15 of 65 *Clethrionomys glareolus*). These results were confirmed by enzyme-linked immunosorbent assay (ELISA). The findings support earlier observations indicating a role for *Clethrionomys rutilus* in natural outbreaks of epidemic hemorrhagic fever. References 14: 10 Russian, 4 Western.  
[123-9642]

GENETICS

UDC 575.1

PREPARATION OF INTERTRIBAL HYBRID ATROPA BELLADONNA/NICOTIANA CHINENSIS  
CELL LINES BY FUSION OF ISOLATED PROTOPLASTS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, 1982  
(manuscript received 18 Jun 82) pp 959-962

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[Abstract] Conditions are described for the preparation of intertribal hybrid cell lines by fusion of *Nicotiana chinensis* ( $2n = 28$ ) and *Atropa belladonna* ( $2n = 72$ ) protoplasts. As a result, 13 clones were obtained which were subjected to cytogenetic and biochemical characterization. The results showed that the cells contained chromosomes from both parental strains and that the ratios of the length of the longest chromosome to the shortest was 6:1 in the hybrid clones, whereas in the tobacco plants the ratio was 3:1 and in belladonna 2.5:1. Evaluation of amylase isozymes found in the hybrid lines and comparison with the *Nicotiana* and belladonna patterns showed both parental types in the hybrid cells. These observations indicated that fusion of *Nicotiana chinensis* and *Atropa belladonna* protoplasts can be employed as a successful model for the creation of intertribal cell lines which, at least on preliminary examination, showed a capacity for stem morphogenesis. Figures 2, references 10 Western.  
[126-12172]

## LASER EFFECTS

### LASER THERAPY

Moscow TRUD in Russian 22 Sep 82 p 3

[Article by A. Rakhishev, corresponding member of the Kazakh Academy of Sciences, honorary president of the International Association for Use of Lasers in Medicine]

[Text] Laser therapy was not born in vacuum--it is in essence further development of radiation therapy, which was known already in antiquity. With the discovery of artificial light sources, radiation therapy began to be used extensively. A qualitatively new stage is linked to the discovery of lasers. Their beams made it possible to administer treatment with strict dispensing of energy, for both the entire body and specific regions or active points.

Two directions emerged in medicine in the early 1970's. Some researchers use high-power lasers, using their "hard" radiation, as medical people say, as a light scalpel. Much work in this direction is being done in oncology, stomatology, ophthalmology and surgery. It can be stated that surgery has become the laser's first medical profession. Researchers pursuing the other direction are studying the effects of low-intensity "soft" radiation from gas lasers. Therapy became the second medical profession of lasers. Work in this direction was begun for the first time in Kazakhstan.

Scientists are particularly interested in studies of the effects of "soft" radiation on the nervous system. The object of investigation includes the central, peripheral and autonomic systems. We undertook the task, in the Department of Normal Anatomy of Alma-Ata Medical Institute, of determining the optimum mode of irradiation and breadth of therapeutic effects of lasers on recovery processes in nerves. A series of experiments led to the conclusion that laser radiation has a stimulating effect; special experiments demonstrated faster growth of nerve fibers, an effect that had not been known previously.

Work on use of laser radiation for therapy is being pursued in the most diverse branches of medicine. Studies are being conducted in laboratories of Kazakh University, Alma-Ata Medical Institute, Institute of Pediatrics of this republic's Ministry of Health, in many other institutes and clinics. For example, in the first pediatric hospital in the capital of Kazakhstan, a method of treatment of bronchitis is undergoing clinical trials, and some encouraging results were obtained with treatment of bronchial asthma. Patients who have undergone a full course of therapy showed an increase in vital capacity and maximum pulmonary ventilation. Attacks disappeared completely

or else occurred much less often. "Soft" lasers are used with success in the clinical practice of this medical institute's department of stomatology.

Laser beams are beginning to be used for treatment of rheumatoid polyarthritis, gynecological and a number of other diseases. Experiments dealing with the mechanism of therapeutic effects of monochromatic polarization red light on inflammation have yielded rather good results; evaluation is being made of its effect on hemopoietic organs, in the treatment of various skin diseases, sore throat and acute laryngitis. In Moscow and Novosibirsk, laser therapy has succeeded in improving the condition of patients with ischemic disease; and it is used in Minsk for benign tumors.

Today, we can state with complete certainty that low-intensity laser radiation affects physiological parameters of many processes. However, I should like to warn the readers against hasty conclusions to the effect that a new universal remedy has been found, a panacea against all diseases. Analysis of clinical studies shows that beneficial results are usually obtained with mild forms and early stages of diseases. One must also bear in mind that, in some cases, a psychotherapeutic effect is apparently involved. Finally, a complete cure cannot be obtained with regard to a number of complicated diseases, and only temporary improvement in the patient's condition is obtained. This is the usual result when the effect, rather than cause, of disease is treated.

Let us take, for example, hypertension. As described by K. Sudakov, corresponding member of the USSR Academy of Medical Sciences, director of the Institute of Normal Physiology, this disease is merely the tragic finale of a long chain of complications in the human nervous system, and for this reason paying attention only to its final phase is a great mistake on the part of modern medicine. Indeed, this condition begins with virtually undetectable chemical reactions in molecules of brain matter, which sum up everything a man has experienced over his entire life: negative emotions, brief and prolonged troubles.

Expressly Soviet scientists succeeded in proving that hypertension is formed in the central nervous system. They disclosed several mechanisms of this process, by means of which stress and prolonged negative emotions lead to stable elevation of pressure.

Yet, 10 years ago, some scientists drew hasty conclusions about the miraculous effects of laser beams in treatment of hypertension. At the present time, none of the authors of previously published works, who obtained "good" results at that time, uses the method that was discovered then.

There is no need to disrupt the remarkable tradition of Soviet medicine, which consists of prolonged and thorough investigation of new therapeutic methods. Each of them undergoes appropriate trials, is given scientific validation, and a clearcut program of therapy is developed including all indications and contraindications.

The scientists of Alma-Ata and other cities of our country are pursuing in-depth studies of the problem of laser therapy; they are investigating its mechanism on the basis of the results of thousands and thousands of experiments. The task is to improve the quality of research, submit to critical analysis the results

and coordinate all research with the participation of various specialists--physicists, biophysicists, morphologists, pathomorphologists, pathophysiologists and clinicians.

But we also have our own problems. Work would progress better if research laboratories were properly supplied with domestic laser units and set of beam guides for different methods of treating objects under study. The absence in this republic of a dosimetry service and personal protection gear also creates some difficulties.

New experiments are needed. The research that is in progress will definitely help lasers become an effective means of curing ailments.

10,657  
CSO: 1840/58

ELECTRON MICROSCOPE STUDY OF CHANGES IN OTIC LABYRINTH RECEPTORS UNDER EFFECT OF LASERS

Moscow VESTNIK OTORINOLARINGOLOGII in Russian No 4, Jul-Aug 82 (manuscript received 25 Nov 81) pp 39-43

[Article by M. P. Nikolayev, V. F. Anichin, O. P. Tokarev and Yu. L. Tverskoy, Moscow Clinical Hospital imeni S. P. Botkin (chief physician--A. M. Botvinov), Moscow Scientific Research Institute of the Ear, Nose and Throat (director--Prof D. I. Tarasov) of RSFSR Ministry of Health, Department of Otorhinolaryngology of the Leningrad Medical Institute of Sanitation and Hygiene (headed by Prof V. S. Olisov)]

[Text] Technological progress serves as grounds for physicians to search for the most effective and, at the same time, conservative forms of therapy. In this respect, use of lasers in medicine is spreading more and more. At the same time, this agent is still at the initial stage of development in otology, although the prospects (as applied to the otic labyrinth) are unquestionable. Laser radiation aimed at the cochlea elicits changes within a relatively limited area at the site of exposure to it, whereas other structures remain unchanged (Stahle et al., 1972). When the vestibular part of the labyrinth (horizontal or posterior semicircular canals) of monkeys with overt vestibular disturbances was exposed to laser, hearing was retained (Wilpizeski et al., 1972). Our previous studies (M. P. Nikolayev et al., 1977, 1978) revealed that, with use of pulsed neodymium laser aimed at the horizontal semicircular canal of monkeys, morphological changes appear and they are strictly localized in the ampulla of the irradiated canal (deviation of cupula, consolidation and fragmentation, dystrophic changes in receptor elements with sloughing off of the base of the cupula).

All of these data are indicative of the desirability of using lasers in labyrinth surgery, in particular, for Meniere's disease, since they can produce local destruction in the desired part of the labyrinth.

Our objective here was to determine some of the patterns of interaction between laser radiation and the inner ear of animals on the electron microscopic level.

Experiments were conducted on 16 chinchilla rabbits weighing 2 to 2.5 kg. The vertical semicircular canal was exposed to optimum energy, for eliminating vestibular function, from pulsed neodymium lasers of 250 J/cm<sup>2</sup> (O. P. Tokarev et al., 1975).

To assess the laser effect, we used the method of simultaneous isolation and treatment of the cochlear and vestibular parts of the labyrinth (V. F. Anichin, 1979). The contralateral labyrinths, as well as labyrinths of animals that were not exposed to any factor, served as a control. The animals were removed from the experiment 1 h, 3 days and 1 month after exposure to lasers.

When making the preparations (under an MBS-2 microscope), we made a visual assessment of the state of the membranous labyrinth. Hemorrhages were demonstrable in the labyrinthine vestibule, ampullae of all semicircular canals and the main helix of the cochlea in animals of the first series of experiment (6) sacrificed 1 h after exposure to lasers. In the second series (5 animals), there was blood in the ampulla of the horizontal semicircular canal and in the region of the frontal semicircular canal (the latter was not intact). The cochlea showed appreciable plethora of the vascular stria. In the third series (5 animals), no free blood was demonstrable in any of the membranous elements of the labyrinth. The ampulla of the frontal semicircular canal was obliterated.

After visual examination and removal from their osseous sheath, the membranous labyrinths were separated into their elements: ampullae of semicircular canals, utriculus and cochlear fragments. The sacculus was poorly visible due to presence of blood in the labyrinth, and it was also traumatized, so that it was not submitted to examination.

Thus, we examined the following simultaneously in each animal under an electron microscope: utriculus, ampullae of all semicircular canals and 2-3 fragments of the membranous cochlea (from each helix). Ultrafine sections were viewed under a JEM-7A electron microscope.

In labyrinths that were not exposed to laser, the ultrastructural organization of receptors of both the vestibular and cochlear regions conformed entirely to its description in the literature (Ya. A. Vinnikov, 1971; Engstrom, 1960; Wersall, 1960, and others).

In animals sacrificed 1 h after exposure to laser radiation (first series of studies) of the frontal semicircular canal, we observed complete impairment of cellular structure; there were no cellular organelles or nuclear membrane (Figure 1A [photo not reproduced]). In the other receptors, erythrocytes were found both in the endolymphatic space and underlying interstitial tissues (see Figure 1B). In spite of the hemorrhages, the cellular structure of all these receptors remained intact (see Figure 1B). But, at the same time, there were vascular changes in all receptors of animals in the first series. Many underlying capillary vessels were empty and their walls were irregular (see Figure 1Γ).

Like the animals used in the first series of studies, those sacrificed 3 days after exposure to laser (second series) presented erythrocytes in both the endolymphatic space and underlying tissues. There were no structural elements left in the frontal semicircular canal. We were able to observe a number of ultrastructural changes in the other receptors: bent stereocilia (fibrils) and escape of part of the cytoplasm of pillar cells into the endolymphatic space were inherent in the apical surface of ampullar receptors (Figure 2A [photo not reproduced]). Such a state had been observed under the effect of



weightlessness (Ya. A. Vinnikov et al., 1978) and accelerations (V. F. Anichin and A. T. Pakunov, 1980).

There was considerable vacuolization of receptor cell (both vestibular and cochlear) cytoplasm. The nucleus remained virtually intact (see Figure 2B). The nerve endings and myelinated nerve fibers of vestibular and cochlear receptors showed little change. Swelling and clearing of mitochondria were found in some myelinated fibers (see Figure 2B). Erythrocytes were usually demonstrable in underlying blood vessels, which was indicative of resumption of blood flow (see Figure 2Γ).

Examination of labyrinths of animals sacrificed 1 month after exposure to laser radiation, in the third series, was of the greatest interest. This term is an indicator of dynamics of the process. As noted above, visual examination of this series of animals failed to demonstrate hemorrhages in any parts of the otic labyrinth. Nevertheless, electron microscopy revealed erythrocytes in both the endolymphatic space (Figure 3A [photo not reproduced]) and within tissues (see Figure 3B) of all receptors. Fragmentation of part of the cytoplasm and cuticle together with stereocilia (see Figure 3B) was evident in a number of receptor cells of the horizontal semicircular canal in the immediate vicinity of the irradiated area. The changes in cytoplasm of hair cells of all receptors examined were minor, consisting of swelling and transverse striation of mitochondria. There was negligible vacuolization, and the nuclei were unchanged (see Figure 3Γ).

While there were some changes in receptor cells, the supporting elements of all receptors were virtually intact (Figure 4B [photo not reproduced]). As a rule, no changes were demonstrable in underlying blood vessels. But there were erythrocytes adherent to the capillary wall of some vessels in the ampullar receptor of the horizontal semicircular canal situated next to the area submitted to laser radiation (see Figure 4A).

Polymorphous findings were made in myelinated nerve fibers of the utriculus and horizontal semicircular canal: along with relatively little-changed fibers there were also marked pathological states. They consisted of virtually complete disappearance of the axis cylinder, although the myelin sheath was virtually unchanged (see Figure 4B).

There were virtually no demonstrable changes in myelinated fibers of the sagittal semicircular canal (see Figure 4Γ).

Thus, with exposure to lasers with pulse density of about  $250 \text{ J/cm}^2$ , aimed at the frontal semicircular canal, its receptors underwent marked dystrophic changes after 1 month. In all other membranous elements of the otic labyrinth, hemorrhages into the endolymphatic space and underlying tissues (stroma) of receptors were prominent. The structures of receptor and support elements were virtually unaffected, although marked vascular elements were observed. Ultrastructural changes were noted in myelinated nerve fibers, with swelling of caliciform nerve endings of the first type of vestibular cells. The changes in the sagittal semicircular canal that was the farthest from the place exposed to laser radiation were less marked than in the other receptors.

On the basis of the above material, we believe that laser radiation with the parameters used (250 J/cm<sup>2</sup>) has a very localized effect, causing marked dystrophy of receptors in the frontal semicircular canal. The ultrastructural changes in the rest of the receptors of the otic labyrinth were typical of the general biological changes seen under the effect of extreme factors.

#### PHOTO CAPTIONS

1. p 40. Electron microphotograph of otic labyrinth 1 h after exposure of frontal semicircular canal to laser
- A) nucleus of receptor cell in frontal semicircular canal; structure is impaired, there is no nuclear membrane; magnification 6500×
  - B) hemorrhage into underlying cochlear tissues, magnification 4900×
  - B) pillar cell and endothelium of cochlea; structure of cells is completely intact; magnification 4000×
  - Г) underlying vessel of main helix of cochlea, there are no formed blood elements (emptying), uneven surface of its lumen; magnification 10,000×

Key to this, Figures 2 and 3. [and Figure 4]

<i>Me</i> ) microvilli	<i>A</i> ) nucleus	<i>Πp</i> ) pericyte
<i>Cm</i> ) stereocilia	<i>L</i> ) cytoplasm	<i>OL</i> ) axis cylinder
<i>Km</i> ) cuticle	<i>Эp</i> ) erythrocyte	<i>Br</i> ) vacuole
<i>M</i> ) mitochondria	<i>MO</i> ) myelin sheath	

2. p 42. Electron microphotograph of receptors of otic labyrinth 3 days after exposure of frontal semicircular canal to laser
- A) apical surface of utricle; curvature of stereocilia, escape of part of the pillar cell cytoplasm into the endolymphatic space; magnification 10,000×
  - B) basement part of receptor cell of horizontal semicircular canal; marked vacuolization of cytoplasm; unchanged nucleus; magnification 11,000×
  - B) myelinated nerve fibers of utricle; along with normal fiber there is a fiber with altered mitochondria; magnification 6500×
  - Г) underlying supporting elements of spiral (Corti) organ; their structure is intact; there is an erythrocyte in the capillary; magnification 4400×
3. p 42. Electron microphotograph of receptors of otic labyrinth 1 month after exposure of frontal semicircular canal to laser
- A) erythrocytes in endolymphatic space near utricle; magnification 4000×
  - B) receptor of utricle; erythrocytes near its base; large vacuoles in cell cytoplasm; small protuberances originating from pillar cells in the apical part; magnification 3500×
  - B) apical part of receptor cell of horizontal semicircular canal; separation and fragmentation of cuticle and part of cytoplasm together with stereocilia; magnification 12,000×
  - Г) receptor cell of utricle; numerous fine vacuoles, rounded mitochondria with transverse striation; magnification 6500×

4. p 43. Electron microphotograph of receptors of otic labyrinth 1 month after exposure of horizontal semicircular canal to laser
- A) underlying vessel of horizontal semicircular canal; erythrocyte adheres to vascular wall; magnification 6400×
  - B) supporting elements (Hensen's cells) of organ of Corti; well-preserved structure; magnification 4200×
  - B) myelinated fibers of utriculus; no axis cylinder, instead of it there are unstructured irregular-shaped elements; next to them is an unchanged nerve fiber; magnification 15,500×
  - Г) myelinated nerve fiber of sagittal semicircular canal; myelin sheath and axis cylinder are intact; separation of axis cylinder from myelin sheath present only in a very small area; magnification 6400×

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CSO: 1840/426

EFFECT OF ULTRAVIOLET LASER ON UNHEALING WOUNDS

Leningrad VESTNIK KHIRURGII IMENI I. I. GREKOVA in Russian Vol 128, No 1, Jan 82  
(manuscript received 3 Feb 81) pp 95-98

[Article by I. Z. Nemtsev, candidate of physicomathematical sciences, and L. I. Gerasimova, candidate of medical sciences, Department of Acute Thermal Lesions (headed by L. I. Gerasimova, candidate of medical sciences) and Department of Reconstructive Therapy (headed by Prof Z. M. Atayev), Scientific Research Institute of Emergency Care imeni N. V. Sklifosovskiy, Moscow]

[Text] New and promising methods of surgical and general biological treatment by means of laser technology have gained increasing use in medical practice in the last decade.

There has been worldwide recognition of work dealing with the use of lasers in ophthalmology, oncology, dermatology, gastrointestinal surgery and a number of other branches of medicine. Reports have also been published on the use of lasers for treatment of burns [13]. It should be noted that, in virtually all published works dealing with burn treatment, lasers were used as a surgical tool that effected bloodless removal of necrotic tissues.

At the same time, there are several works on therapeutic use of low-intensity lasers in the treatment of surgical wounds, burns and dermatosis [1-3, 6, 7, 8, 11, 14]. We used lasers in combined therapy of 50 burn patients.

Burn wounds remaining after autoplasmic surgery, the onset of which was most often related to autoimmune conflict, which were small in area and scattered in localization, that failed to heal for a long time served as an indication for the choice of this method of therapy. Laser therapy was also used to accelerate epithelialization of small wounds remaining after healing of 3A degree burns, which could not be prepared for autografting, in spite of use of the available assortment of resources in the specialized burn department.

Low-powered continuous lasers were used for therapy.

The helium-neon laser, which emits monochromatic coherent light in the red part of the spectrum has gained the widest use.

There are quite a few publications indicative of the fact that the light from a helium-neon laser acts like a biological stimulator, enhancing regenerative capacity of live tissues [1-3, 6, 7, 8, 11, 14].

We expected that ultraviolet radiation from a nitrogen laser would have a more effective stimulating influence than the red radiation from the helium-neon laser. This belief was based on the following facts.

As we know, wounds that do not heal for a long time "turn sour" (pH shifts in the acid direction), i.e., rather firm chemical bonds between atoms of hydrogen and free radicals are formed in cells with the following energy: H-S bond--3.56 eV, H-N bond--3.62 eV, H-C bond--3.72 eV, which prevent the normal course of enzymatic metabolic reactions involving radicals with free valencies of S-, N-, C- [12]. The energy of the red laser radiation quantum, which is widely used to stimulate wound healing, constitutes 1.95, 1.96, 1.93 and 1.90 eV, which is obviously not sufficient to break these bonds, which are formed in unhealing wounds.

Under these conditions, monochromatic radiation with quantum energy that is sufficient for resonance breaking of chemical bonds of acid atoms of hydrogen with free radicals should have the most stimulating effect on metabolic reactions.

Ultraviolet laser radiation at a wavelength of 3371 Å and with quantum energy of 3.67 eV has such a property, which promotes healing.

The radiation of the laser we used (with quantum energy of 3.67 eV), which causes resonance breaks in N-H (bond energy 3.62 eV, resonance misalignment 1%), N = C (bond energy 3.65 eV, resonance misalignment 0.5%) bonds, also stimulates formation of nitrogen base dimers in DNA of cells in the irradiated surface which, as we know [10], diminishes replicative activity of DNA. The spectral intensity of laser radiation is so high that neither dark, nor light, nor recombinative repair of DNA eliminates injuries it causes, and the cell loses the capacity to multiply. Thus, there is drastic decrease in mitotic activity of cells on the wound surface exposed to ultraviolet (UV) laser (decreased mitosis was also observed in experiments [9, p 48]). This causes concentric contraction of edges of the wound and growth of deep-lying fibroblasts [5], i.e., the UV laser radiation we used effectively stimulates contraction of wounds that do not heal for a long time.

It should also be noted that ultraviolet laser has a stronger bactericidal effect than red laser.

The cross section of the laser beam is a circle 3 mm in diameter. In order to cover with the beam an entire wound several

centimeters in size, the laser beam was scanned manually over the entire wound surface in order to stimulate the process of concentric contraction of its margins and growth of fibroblasts at the bottom of the wound. There is minimal divergence of the beam, and it constitutes several tens of angular seconds. For this reason, treatment can be administered with placement of the laser at any distance from the patient (up to several meters). The power of the beam varied from 4 mW to 100  $\mu$ W. This does not cause temperature rise at the irradiated site, nor can it cause a burn. In selecting the dosage, we were governed by experimental data obtained with use of nitrogen laser, which did not demonstrate any adverse effects on animals [4, 9].

In our clinical studies, laser therapy was used for 50 patients with burns over 5 to 55% of their body, which were present when they were admitted to the department. There were 21 women and 29 men, ranging in age from 19 to 69 years. Most patients had undergone surgery.

Skin autografts had been performed on areas of 1 to 30% of the body surface.

At the time laser therapy was begun, there were 3 to 30 small, scattered burn wounds, which remained after skin autografts or persisted in the course of spontaneous healing of 3.A. degree burns (in unoperated cases). Their size ranged from 0.5 to 10  $\text{cm}^2$ . The overall area of remaining burn wounds constituted tenths of a percentage point to 3%.

Localization of burn wounds was as follows: ankle region in 22 cases, hip region in 10, back, chest and arms in 13 and hands in 12. There were combined burn wounds in the region of the upper extremities and hip joints in five cases.

Treatment was administered in the following manner. The laser head was manually moved so that the beam scanned the surface of the burn wound. The intensity of the beam varied from 4 to 0.1 mW. The optimum single dose constituted 0.1  $\text{J}/\text{cm}^2$ , which corresponded to 30 s/ $\text{cm}^2$  at maximum beam power. We gave 4 to 15 laser treatments. Exposure time per wound ranged from 15 s to 3 min, depending on its size. Treatments were given daily, except for holidays [days off].

In the course of laser therapy, we found that the patients tolerated this method of treatment well. There were no side-effects either during laser therapy or after termination thereof. The patients reported attenuation of the pain syndrome, and edema diminished. Pulse, arterial pressure and respiration remained stable. There was no impairment of diuresis and intestinal function. Use of lasers had no appreciable effect on the temperature curve. When measured locally, at the edge of the wound, the temperature fluctuations constituted  $\pm 0.2^\circ\text{C}$  before and after a treatment. Analysis of peripheral blood showed a decrease in leukocyte count and erythrocyte sedimentation rate to normal levels.

Observations revealed that growth of marginal epithelium appeared already after two laser treatments in the case of the smallest

wounds, and there was complete epithelialization after 3-4 treatments. In the case of burn wounds 4-10 cm<sup>2</sup> in size, growth of marginal epithelium appeared at about the same time, but final epithelialization occurred after 6 treatments. With larger burn wounds, epithelialization required 7 to 15 treatments. Solutions of furacin [nitrofurazone] 1:5000 and 0.5% silver nitrate were used when dressings were changed. It should be noted that daily change of dressings with the same solutions or other agents for local treatment of burns, which preceded laser therapy, showed no tendency toward independent epithelialization of remaining wounds. General therapeutic agents (antihistamines, anabolic hormones, vitamins, increased nutrition and others) also failed to affect wound healing.

Laser therapy was effective in virtually all cases. The effect consisted of the fact that burn wounds, which had not healed for 3-8 weeks in spite of all general and local methods of therapy, underwent epithelialization after 4-15 laser treatments.

In no case did we observe formation of rough cicatrices or keloids in the region exposed to the laser beam. A recheck of the patients 2-8 months after completion of therapy and discharge from the hospital showed no recurrence of trophic ulcers, edema and other inflammatory or allergic manifestations inherent in dermatitis, which is often observed in patients with unhealing burn wounds. There was good functional adaptation of transplanted skin autografts, and most patients returned to work.

Our results warrant the belief that UV laser therapy is quite promising in the combined therapy of burn victims whose wounds do not heal for a long time.

Thus, ultraviolet laser therapy, which we administered to 50 patients with unhealing burn wounds, elicited a positive effect, as manifested by healing within 4 to 15 days, while all previously used methods of systemic and local treatment of analogous patients had been unsuccessful, in spite of competent and prompt use thereof in a specialized burn department for several months.

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EFFECT OF PULSED LASER RADIATION ON EHRLICH'S ASCITES TUMOR CELL LYSOSOMES

Leningrad VOPROSY ONKOLOGII in Russian Vol 28, No 4, Apr 82 (manuscript received 14 Jul 81) pp 42-44

[Article by K. G. Moskalik, Ye. M. Ryazanov, V. V. Lazo and K. Merkle, Order of Labor's Red Banner of Scientific Research Institute imeni Prof N. N. Petrov, USSR Ministry of Health, Leningrad]

[Text] A study was made of the effect of neodymium laser radiation ( $\lambda = 1.06 \mu\text{m}$ ) on lysosomes of Ehrlich's ascites tumor cells. It was demonstrated that, with laser radiation energy density of 10-100 J/cm<sup>2</sup>, 1-4 h after in vitro exposure of tumor cells there was synchronous increase in free and total activity of acid phosphatase in the fraction of isolated lysosomes, which is the result of labilization of cytoplasmic membranes of tumor cells. It was also determined that laser radiation in the tested doses does not affect activity of acid phosphatase in an enzyme preparation.

Key words: Ehrlich's tumor, laser radiation, acid phosphatase.

At the present time, the mechanism of antiblastoma effect of pulsed laser radiation has not yet been fully investigated [2]. At the same time, there is information to the effect that the lysosome system plays an important part in expression of the antineoplastic effect of a number of physical and chemical agents [8]. Our objective here was to examine the reaction of tumor cell lysosomes to neodymium laser radiation. We assessed the effect of laser radiation on lysosomes on the basis of change in activity of the marker enzyme of lysosomes, acid phosphatase (APase, EC 3.1.3.2).

#### Material and Methods

Experiments were performed with Ehrlich's ascites tumor cells inoculated in adult male SHR white mice weighing 18-20 g. On the 7th day after transfer, tumor cells from 8-10 animals were exposed to lasers in glass trays containing 1 ml ascites fluid, using 10 pulses of laser radiation with energy density of 10, 25 and 100 J/cm<sup>2</sup>. A neodymium type GOS-1000 laser (wavelength 1.06 nm, pulse duration 1 ms) served as the source of laser radiation. After this, the specimens were kept at 4-6°C for 1 or 4 h, then the cells were precipitated by centrifugation at 80 G for 15 min (4°). The sediment was eluted in 0.25 M

saccharose (pH 7.4) twice. The mixed mitochondrial-lysosomal (800-27,000 G) and soluble fractions were recovered as described previously [6]. To recover solubilized enzyme, the precipitate of tumor cells was submitted to 3-fold freezing-thawing in liquid nitrogen and grinding with quartz sand in 0.25 M saccharose [7].

We determined APase activity in lysosomes, soluble fraction and the enzyme preparation. One ml of incubation medium contained 1  $\mu$ mole n-nitrophenyl phosphate (Merck Company), 1  $\mu$ mole magnesium acetate, 50  $\mu$ mole tris-acetate buffer (pH 4.5, 5.0) and 0.77 M saccharose. Polysaccharide content was determined according to Smith and Monthomery [10]. Protein concentration was assayed by the microbiuret method [3] and spectrophotometrically [9].

We examined the effect of laser radiation on the cytoplasmic membrane of tumor cells using a modification of the method in [5]. For this, aliquots of suspensions of irradiated and control cells were incubated in a solution of 0.15 M NaCl (pH 7.4) containing detergents, triton X-100 or dodecylsulfate (sodium salt) or polymyxin in end concentrations of 0.01-0.1%, 0.01-0.1% and 0.002-0.01%, respectively. The samples constituted 1.0 ml in volume. After incubation for 10 min at 37°, the volume of the samples was brought up to 3 ml with 0.15 M NaCl solution, and the cells were precipitated by centrifugation at 80 G for 15 min. The sediment was discarded. The supernatant was centrifuged at 27,000 G for 10 min. We determined the degree of labilization of cytoplasmic membranes on the basis of increase in yield of solubilized material absorbed at wavelengths of 228.5, 234.5, 260 and 280 nm.

#### Results and Discussion

It was established that exposure of Ehrlich's tumor cells to laser radiation leads to simultaneous increase in free and total APase activity in the fraction of isolated lysosomes (the effect was the most marked with energy density of 10-15 J/cm<sup>2</sup>), and it had no appreciable effect on activity of the enzyme in the soluble fraction. At the tested levels of energy density, laser radiation also failed to affect APase activity in preparations of solubilized enzyme, which rules out the possibility of its inactivation.

In view of the low probability of induction of APase (or lysosome) synthesis under the experimental conditions, it could be assumed that the increase in activity of the enzyme is due, for example, to a change in physicochemical properties of the protein-lipid shell of plasma membranes of tumor cells, which thus leads to a decline in resistance of the latter to the homogenization procedure. An increased discharge of lysosomes from irradiated cells would be a consequence of this. However, experiments conducted to check this hypothesis failed to demonstrate an increase in discharge of material that absorbs in the ultraviolet part of the spectrum from irradiated cells. Nor was an increase demonstrated in amount of sugars in the incubation medium, which could be indicative of "chipping" of polysaccharides from the surface of cell membranes, as was shown, in particular, with exposure to ultraviolet radiation of Zajdela hepatoma cells [4]. In a search for a more sensitive method, that would enable us to detect the assumed damage to cytoplasmic membranes, we tested the resistance of control and irradiated cells to detergents. The results obtained from these experiments revealed that laser radiation with

energy density of 10-100 J/cm<sup>2</sup> stimulates loss by cells of material that is absorbent in the ultraviolet part of the spectrum, which was caused by the deleterious effect of detergents.

These data are indicative of a substantial change in structure of cytoplasmic membranes of Ehrlich's tumor cells under the influence of laser radiation. Since we failed to demonstrate damage to the glycocalyx, it can be assumed that the demonstrated changes are expressed on the level of the lipoprotein elements of plasma membranes. A change in cytomembranes of tumor cells under the effect of lasers was also demonstrated in electron microscopic studies thereof [1].

Thus, the increase in APase activity observed in the first few hours after exposure of Ehrlich's tumor cells to laser radiation is attributable to labilization of cytoplasmic membranes, which leads to the phenomenon of increased discharge of lysosomes. Acid phosphatase, like certain other enzymes [2], is resistant to laser radiation.

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NEW MAGNETOTHERAPY UNIT--ZVEZDA--UPDATE

Moscow TRUD in Russian 27 Jul 82 p 2

[Letter to the editor: "Answer to TRUD About the 'Star' of Doctor Yepifanov"]

[Text] "'Zvezda' [the Star] of Doctor Yepifanov" was the heading of a report published in TRUD on 29 April of this year on a problematic topic. It stated that, for many long years, a unit that is effective in the treatment of a number of diseases has been unable to make any headway.

O. Shchepin, first deputy USSR minister of health, responded to the editorial board. He reported that the newspaper had raised a timely problem. A special commission of the ministry was created to learn about the unit of Dr A. Yepifanov.

The commission heard the report of Dr A. Yepifanov, talked with patients who had undergone a course of therapy. A thorough analysis was made of case histories and outpatient charts of 153 patients who had been treated with the Zvezda unit.

On the basis of the findings of this commission, the USSR Ministry of Health issued an order, which calls for a number of measures to settle the problem of introducing the Zvezda magnetotherapy unit into medical practice. The ministry made it incumbent upon directors of scientific research institutes of biophysics, medical engineering, balneology and physiotherapy to assign specialists for comprehensive investigation of the unit. The director of the Institute of Surgery imeni A. V. Vishnevskiy, USSR Academy of Medical Sciences, was charged with conducting clinical trials of Zvezda from 1 October to 15 November of this year.

The specialists under the ministry, together with the designer of this unit, have worked out a method of screening patients and criteria for determining the efficacy of therapy.

At the same time, the commission noted that the unit must be checked for electric safety. It is imperative to conduct combined research using modern methods to determine indications and contraindications for the use of Zvezda.

Two refined experimental versions of this unit will be manufactured at the expense of the USSR Ministry of Health. Permission was granted to add 17 regular staff members to Ryazan Municipal Hospital No 11, where A. Yepifanov is working, to implement the additional research on this matter. Diverse equipment was furnished to the hospital. Ryazan physicians will receive such unique equipment as "resplethysmograph" [?], a radioisotope laboratory, "Tsunami" cardiological complex and electrocardiograph. Control was instituted to see that the order is followed.

MAGNETIC FIELD IN TREATMENT OF STUMP PAIN SYNDROMES

Moscow ORTOPEDIYA, TRAVMATOLOGIYA I PROTEZIROVANIYE in Russian No 6, Jun 82  
(manuscript received 15 Jun 81) pp 8-12

[Article by V. V. Kuz'menko and Yu. D. Kats, Department of Traumatology, Orthopedics and Military Field Surgery (headed by V. V. Kuz'menko, doctor of medical sciences), Second Moscow Medical Institute imeni N. I. Pirogov]

[Text] Stump pain syndromes are a rather disturbing complication of any amputation. In the opinion of a number of authors, the phantom pain syndrome occurs in 30% of patients submitted to amputation [1, 4].

However, there is still no effective enough method of treating the postamputation pain syndrome. Neurosurgical intervention (neurotomy, transection of ascending pathways on all levels, stereotactic operations) often causes recurrences, not infrequently it is labor-consuming and traumatic, and it is performed only in specialized clinics [4].

The widely used conservative methods of treatment--ultrahigh-frequency, microwave therapy, Bernard currents, sinusoid-modulated current, ozocerite [mineral wax], mud therapy, hydrotherapy, X-ray therapy, psychotherapy--are also not effective enough [2].

In 1975, the first report appeared on the use of magnetotherapy for treatment of stump pain syndromes [2]. In the opinion of the authors, magnetotherapy is the method of choice in the treatment of phantom and postamputation pain. However, the proposed method could not gain wide use because of the need to use a special unit that the medical industry does not manufacture.

We have been using the Soviet, series-produced Polyus-1 unit since 1976 at the Moscow Hospital for Veterans of the Great Patriotic War.

We had 240 patients under observation, mainly veterans ["invalids"] of the Great Patriotic War, ranging in age from 55 to 75 years. Amputation of the limb had been performed on the level of the thigh in 182 cases, lower leg in 46, shoulder [upper arm] in 8 and forearm in 4. In 178 cases, the amputation was performed due to a gunshot injury, in 44 due to chronic osteomyelitis with malignification of fistulas and ulcers, in 48 due to vascular atherosclerosis obliterans, mainly of the lower extremities. Duration of illness ranged from 1 to 35 years.

The symptomatology of amputation-related pain has been described rather comprehensively. However, some forms of stump pain encountered at the present time among veterans of the Great Patriotic War require special consideration, since they determine therapeutic tactics.

Phantom pain was compressing, aching, twisting, cutting and piercing in nature. It appeared upon a deliberate effort to arrest the sensation of motion of spontaneously moving digits and, on the contrary, to move the digits. The phantom sensation of the size of the limb changed with passage of time. While a "fresh" phantom usually corresponded in size to the lost part of the limb or was larger [1], with age and, occasionally, during therapy the phenomenon of "shortening of the phantom" appears. We observed a patient who felt that his toes "are growing right out of the thigh stump." If such a phenomenon appears during therapy, it is usually a good sign indicative of an impending remission.

If the phantom pain is burning in nature ("as if red-hot coals had been poured over the foot"), causalgia is present. This is a manifestation of stimulation of the sympathetic nervous system. Causalgia is markedly intensified as a result of heat treatments or simply when ambient temperature rises.

The so-called phantom sensation or perception of the missing part of the limb as being real, but without pain, occupies a special place. We do not consider this to be a pathological state, since it helps use a prosthesis, equating its image to the sensation of a really existing limb.

Sometimes, the amputation pain syndrome is topically localized. It is manifested in the form of intensive pain in some part of the stump. Usually, there are pulling, aching, explosive types of pain. As a rule, it is impossible to use a prosthesis when there is exacerbation of pain. The stump is usually edematous, hypersensitive and muscular movements are limited because of pain. The amputation pain syndrome can be combined with causalgia.

There are typical clinical signs in the case of painful neuroma. This form of stump pain syndrome should be considered more a clinical concept than a morphological one. Neuroma, as an anatomical structure, is present with all forms of the pain syndrome. However, a specific nature of pain is inherent in painful neuroma. The pain is perceived as a strong electric shock. Depending on the intensity of the sensation, either the stump or the patient's entire body "twitches." The shocks may occur singly or in series. The interval between them could range from a few seconds to hours. At the stage of irritation, this form is the most difficult to tolerate by patients, often leading to suicide attempts and drug addiction. The nature of the neuroma depends on where the painful discharge irradiates. If irradiation is perceived in the amputated part of the limb there is a phantom neuroma, if it is in the stump it is amputation neuroma. The stump is slightly edematous, extremely sensitive and tender to palpation in the region of the neuroma. The neuroma is palpated as a tender round formation.

In 23% of the cases, we observed a mixed form of phantom pain syndrome. As a rule there was prevalence of one syndrome combined with a relatively mild element of the second one. With the phantom pain syndrome with an amputation component, against the background of typical phantom pain there was tenderness

of the stump, which was less intensive than the main pain syndrome. The reverse also occurred.

As time passed and sometimes during therapy, one form changes to the other, and there may be a combination of several clinical forms together. Thus, the stump pain syndromes are quite heterogeneous and consist of different forms that require different methods of treatment and use of magnetic fields.

We make a distinction between the following main forms of amputation sensations: 1) phantom pain syndrome; 2) amputation pain syndrome; 3) painful neuroma; 4) phantom sensation; 5) mixed form. In turn, the phantom pain syndrome may or may not be associated with causalgia, with or without the amputation component.

The amputation pain syndrome may or may not be associated with causalgia, with or without the phantom component. Painful neuroma is manifested by amputation and phantom types of pain. The phantom sensation may be unpleasant, but without a pain component.

In addition, there are stages of amputation pain sensations. We make a distinction of seven stages. The first is irritation. It develops when analgesia is ineffective or given with delay in the case of acute development of an attack. It can last from 2-3 days to several weeks, driving the patient to a state of stress and complete depletion of reactivity of the body. Even strong, courageous individuals are so depressed by pain that they can shout, cry, behave inadequately and attempt suicide. If the pain occurs sporadically, in the intervals between attacks the patients fall into a state of prostration, they do not react to stimuli and, not infrequently, fall asleep. White blood cells show the typical signs of stress: drop in lymphocytes to less than 20%, disappearance of eosinophils and leukocytosis exceeding 9000. This is not a favorable stage for magnetotherapy [3].

The second stage is an acute pain syndrome or partial irritation. It appears spontaneously or is transitional. The pain syndrome is very marked, but patients with good self-control can make contact. Their sleep and appetite are impaired, and pain is constantly dominant. Blood findings are also typical of stress. Magnetotherapy as an independent method of treatment is also ineffective.

The third stage is "habitual" exacerbation. The pain syndrome is quite intensive, but its severity does not exceed the level to which the patient is accustomed and psychologically prepared. Appetite is usually somewhat diminished. Sleep is superficial. Attention is scattered, but the patient searches for a distraction, tries to keep busy with something, and by will power forces himself to "forget" about the pain. White blood findings are typical of chronic stress [3].

The fourth stage is referable to unstable improvement. It is a transitory stage characterized by periods of complete absence or drastic reduction in intensity of pain for 4 to 12-15 h followed by periods of recurrence (10-15 min to 1 h). As a rule, the patient is highly active, displaying elation and euphoria. Blood findings are consistent with increased activity [3].

The fifth stage is partial remission. The pain syndrome may be absent for several days or even weeks, and with a change in the weather, mental stress,

exacerbation of concomitant or intercurrent disease (acute respiratory disease, influenza) there may be recurrence of brief (15-0 min) but intensive attacks (however, their intensity does not exceed the "customary" level). Sleep and appetite are normal. Blood findings correspond to calm activity [3].

The sixth stage is remission. The pain syndrome is virtually absent, but occasionally there is mild and brief pain. Sleep and appetite are stable. The patient is calm and his behavior is adequate. Blood findings are consistent with conditioning reaction [3].

The seventh stage is recovery. The pain syndrome has been absent entirely for many years. There is complete social adaptation.

We proceeded from the following main principles in treatment of stump pain syndromes: 1) The most favorable stage for magnetotherapy is the "stage of habitual [customary] exacerbation.

2. Stage of irritation or acute pain syndrome is not good for magnetotherapy; the pain should be treated by any possible method (phantom pain with acupuncture, amputation pain and painful neuroma with novocain blocks, analgesics, long-term peridural anesthesia) without allowing the attack of pain to develop.

3. Phantom pain and amputation pain syndromes require various methods of magnetotherapy, since the amputation pain syndrome is local and responds to local therapy, whereas phantom pains that have corticosubcortical pathophysiological substantiation require treatment of autonomic structures and autonomic conduction pathways.

4. During therapy, white blood must be checked twice a week, and dosage should be changed in accordance with adaptation reactions [3].

Method of treatment: For the phantom pain syndrome, determination is made of "localization" of pain in the phantom by questioning the patient, and the proper acupuncture canal is chosen that passes along the limb and trunk. We described the method of choosing a canal previously [5]. We then place the inductors of the Polyus-1 unit, with U-shaped core and 3-5 cm space between it and the body over the canal point in the region of the stump or trunk, guiding the lines of force of the magnetic field in a distal direction along the canal.

The pulsed magnetic field induced by the Polyus-1 unit is delivered in the continuous mode with output intensity of 8-10 m/T. At this time, it is necessary to determine the dynamics of the patient's sensations. The distance between the inductor and body or angle of the inductor pointer is changed on the basis of changes in sensations, so that either complete disappearance of pain or appearance of pleasant sensations is obtained. They include appearance of heat in the zone of pain, sensation of pleasant vibration running over the missing foot in a transverse direction, sensation of phantom but without pain, phenomenon of the phantom approaching the stump. As soon as the patient reports appearance of such sensations, the unit timer is set for 15 min of exposure, the site to which the inductor is exposed is marked on the body and on the chart. The course of therapy involves



18-20 daily treatments, seldom are 25 necessary. This method has been named "magnetopuncture," by analogy to electropuncture and laser puncture.

In the case of the amputation pain syndrome, determination is made of the most tender region by palpation. Inductors are set above it tangentially at a minimal distance, and the pointers on the inductors are set in mutually opposite directions. A variable magnetic field is delivered in an intermittent mode at maximum intensity. Exposure time is 15 min, and a course of therapy consists of 18-20 daily treatments.

In the presence of painful neuroma, consideration is given to whether the phantom or amputation components dominate. With prevalence of the phantom component, one inductor with a straight core is placed above the neuroma and the other over the point of the involved canal. The intensity of the field and mode are selected on an individual basis, as described above. If there is amputation type pain, the inductors with straight cores are placed tangentially over the neuroma. The field is variable, used in intermittent mode at maximum intensity.

Attempts at using magnetic fields regardless of stage or form of process revealed that success can be achieved only with due consideration of the main and dominant components, since their pathogenesis is not the same.

Results of magnetotherapy of stump pain syndromes

Main form of pain syndrome	Variants of main form	Cases		Results of treatment			
		abs.	%	excellent	good	satisfactory	unsatisfactory
Phantom	Without causalgia	72	30	5	43	21	3
	With causalgia	13	5,4	—	8	4	1
	With amputation component, no causalgia	1	0,5	—	1	—	—
	) with causalgia	3	1,25	—	2	1	—
Amputation	Without causalgia	63	26,25	4	38	17	4
	With causalgia	3	1,25	—	2	1	—
	With phantom component, no causalgia	3	1,25	1	2	—	—
	) with causalgia	6	2,5	—	1	3	2
Painful neuroma	Phantom type	25	10,4	2	16	6	1
	Amputation type	38	15,8	3	23	11	1
Transitional		13	5,4	2	8	2	1
	totals	240	100	17	144	66	13

If we consider the phantom pain syndrome as a manifestation of a static focus of excitation in the sensory cortex of the brain, it is understandable why a paradoxical reaction to therapy is observed. As a rule, the desired effect is not observed from intensive local stimulation by some factor or other, including a magnetic field, whereas very mild, virtually unperceived stimulation along the pathway of autonomic conduction elements and acupuncture points is capable of eliminating the pain dominant from the central nervous system and replacing it with the dominant sensation of mild heat and pleasant vibration.

The amputation pain syndrome localized in the stump is caused by neuritis of severed nerves, thrombophlebitis or thromboarteritis, bursitis, myositis, which develop under the influence of osteophytes, as a result of neurotization of the cicatrix, etc. In such cases, intensive local therapy is effective.

With painful neuroma, prevalence of one component or other also determines the strength and target of magnetotherapy.

Magnetotherapy is also ineffective at the irritation stage, and it could even intensify the pain syndrome. The therapeutic effect is inadequate in the presence of so-called mixed forms.

In assessing the results of treatment, we took into consideration the stage of the process at which therapy was administered and the stage resulting from magnetotherapy used only when the syndrome had been changed from the stages of irritation and partial irritation by other methods.

The results were considered excellent when recovery lasted 3 or more years. A stable partial remission was considered a good result. The result was deemed satisfactory with unstable improvement and poor with persistence of the stage of "habitual" exacerbation.

Analysis of the results of magnetotherapy followed up for periods of up to 3 years, which are listed in the Table, revealed that it was effective in 227 out of 240 patients (94%), and in 161 of them (67%) we could refer to complete or virtually complete cure.

Our observations revealed that magnetotherapy of stump pain syndromes, with due consideration of form and stage thereof, is a rather effective method and should take the place it deserves in treatment thereof.

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ELECTRIC SENSE IN FISH (NEWS IN LIFE, SCIENCE AND TECHNOLOGY: 'BIOLOGY' SERIES)

Moscow ELEKTRICHESKOYE CHUVSTVO RYB (NOVOYE V ZHIZNI, NAUKE, TEKHNIKE: SERIYA "BIOLOGIYA") in Russian No 4, Apr 82 (signed to press 30 Mar 82) pp 2, 29-32

[Annotation and excerpt from book "Electric Sense in Fish (News in Life, Science and Technology: 'Biology' Series)", by Gerbert Romanovich Broun, candidate of medical sciences, Vladimir Rustamovich Protasov, doctor of biological sciences, and Gennadiy Aleksandrovich Fonarev, candidate of physicomathematical sciences, Izdatel'stvo "Znaniye", 38,650 copies, 64 pages]

[Text] This pamphlet deals with key problems of physiology of the electric sense in fish: formation of effective stimulus, primary, receptor mechanisms, questions of pulsed coding of electric information, behavioral aspects of electroreception, as well as data on electric fields of natural reservoirs.

Gerbert Romanovich Broun, candidate of medical sciences, on the staff of the Institute of Physiology imeni I. P. Pavlov, has been working for many years on various problems of physiology of electroreceptors of fish. Vladimir Rustamovich Protasov, doctor of biological sciences, recipient of the State Prize, head of the Laboratory of Problems of Fish Orientation at the Institute of Evolutionary Morphology and Ecology of Animals imeni A. N. Severtsov, USSR Academy of Sciences, is concerned with problems of electroecology. Gennadiy Aleksandrovich Fonarev, candidate of physicomathematical sciences, senior scientific associate at the Institute of Earth's Magnetism, Ionosphere and Propagation of Radiowaves, USSR Academy of Sciences, works on problems of electromagnetic fields of the ocean.

#### Fish Sensitivity to Magnetic Fields

The high sensitivity of electroreceptors to electric fields led to the assumption that, under certain conditions, they could perceive magnetic stimuli, in particular, earth's magnetic field and its natural fluctuations. This hypothesis was entirely justified in the studies of the school of Professor O. B. Il'inskiy, to which one of the authors of this pamphlet belongs.

It must be stated that the possibility of perception of magnetic fields by vertebrate animals had been discussed in the scientific literature since the middle of the last century. This question was first posed on a scientific level in 1955 by the Russian academician, A. T. Middendorf, who assumed that birds could orient themselves by the geomagnetic field. Somewhat later,

an analogous hypothesis was expounded with reference to fish. However, until electroreceptors were discovered these hypotheses remained unconfirmed.

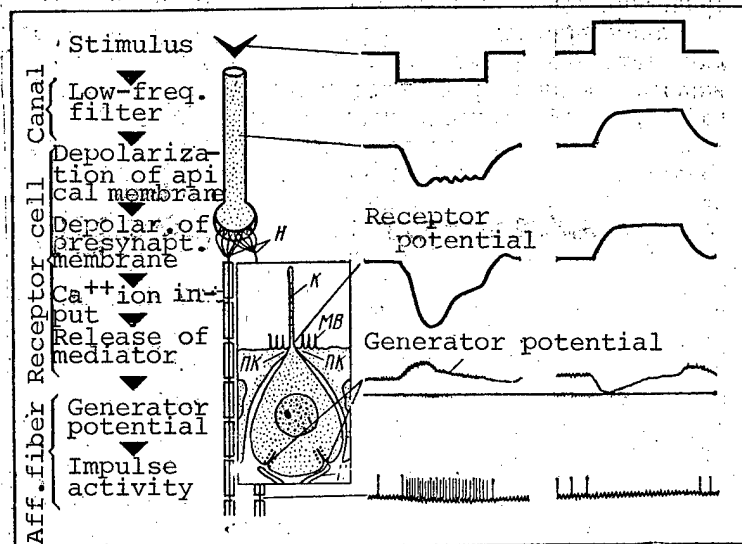


Figure 6. Mechanism of function of the ray's Lorenzini ampulla. Schematic illustration of contact of one nerve fiber (H) with numerous receptor cells. An isolated receptor cell with a kinocilium (K) is shown at great magnification, it has dense contacts (IK) that connect it to sustentacular cells that have microvilli (MB) surrounding the receptor cell kinocilium. On the right, schematic illustration of changes in potentials in different parts of the ampulla. Positive changes in potentials correspond to upward deflection. On the left, series of receptor mechanisms for an excitatory stimulus (Andrianov, Broun, Il'inskiy, 1979).

With the discovery of electroreceptors, the problem of perception of magnetic fields by fish (and, perhaps, other animals) received a new stimulus for development. It became possible to use methods of sensory physiology (for example, derivation of impulsation from a nerve fiber) to study it. It was found that the ray's Lorenzini ampulla is extremely sensitive to a magnetic field going through the fish's body vertically. And it is sensitive expressly to a change in the field, because a static magnetic field is not associated with any perceptible changes in frequency of nerve impulses in the fiber going away from the ampulla. The impulse frequency for each given ampulla is determined by the location of the ampullar channel in relation to concentric induction current, which arises in the fish's body with change in the magnetic field, in accordance with the law of electromagnetic induction.

This was proven in experiments with an ampullar canal isolated from body tissues. The canal could be put in different positions on the body, and in all cases the reaction of receptors with change in the magnetic field corresponded to the position of the canal in relation to induction current.

Current entering the ampulla elicited inhibition of impulsation in the nerve fiber and current exiting from the ampulla elicited excitation thereof. Other conditions being equal (location of canal, speed of build-up of magnetic field), the impulse frequency in the nerve fiber is proportionate to length of the canal. This is also indicative of perception by electroreceptors of an induction electric field.

Unlike Lorenzini's ampulla of salt-water fish, the electroreceptors of fresh-water fish do not react to change in the vertical magnetic field. This is attributable to the fact that, with change in magnetic field, there is a drop in tension of tissues of the body's endogenous environment (which can be perceived by Lorenzini's ampullae), but there is no drop of tension on the skin of the fish. Yet it is expressly to perception of this pressure drop that the electroreceptors of fresh-water fish are adapted. For some time, it was even believed that the electroreceptors of fresh-water fish are generally incapable of reacting to magnetic stimuli, because of the shortness of the ampullar canal. However, it was found that these receptors are very sensitive to movement of a permanent magnet above the fish. Typically enough, reactions appear only if the fish is surrounded by water, but not when it is in the air. In other words, the reaction to a magnetic stimulus occurs only when the induction electric field creates a tension drop on the skin of the fish. The sensitivity of electroreceptors of fresh-water fish (for example, the Turkestan catfish) to such stimulation is sufficient for perception of earth's magnetic field when the fish or water move under natural conditions.

Experiments have shown that, in the case of moving water, there are distinct electroreceptor reactions to a static magnetic field as well. The magnitude of the reaction is a virtually linear function of intensity of the magnetic field and rate of water flow in relation to the fish. The location of the ampullar canal in relation to moving water is also important. If the canal is parallel to the flow of water there is no reaction to a static field; only the response to a field change persists. If the same ampulla is at an angle to the direction of water flow, the reaction appears. These data indicate that an animal can determine the direction and velocity of water flow in a magnetic field by means of electroreceptors.

Impulsation responses also arise in a static magnetic field when a fish moves in motionless water. Then the magnitude of the reaction is determined by the direction of magnetic force lines and direction of the fish's movement, whereas the intensity of the response depends on the magnitude of the magnetic field and velocity of fish movement. Fish movement in a magnetic field elicits opposite responses in symmetrical ampullae of the right and left halves of the body (Figure 7 [not reproduced]). When the fish moves in water, electroreceptors can perceive not only the vertical component of earth's magnetic field,\* but the horizontal component. Such perception, which actually signifies compass orientation, should be effected by vertically situated Lorenzini ampullae. Sharks, for example, have such ampullae. It is still not known whether fish make use of this in their orientation and navigation.

\*At moderate latitudes, earth's magnetic field is at an angle to the horizontal plane, i.e., it has vertical and horizontal components.

It is very interesting to study magnetic sensitivity of electroreceptors, not only because the possibility of perception of earth's magnetic field by vertebrates was first proven on their example, but with regard to bionic modeling. By using the operating principles of electroreceptors, scientists can build diverse sensors (of velocity of movement in relation to environment and bottom, detection of metal objects in water, etc.).

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## ADVANCES IN BIOPHYSICS IN USSR

Moscow MOSKOVSKAYA PRAVDA in Russian 7 Aug 82 p 2

[Article by N. Emanuel', academician, Hero of Socialist Labor, recipient of Lenin Prize: "Biophysics--Nature--Man"]

[Text] This week, the First All-Union Biophysics Congress convened in Moscow. More than 1000 specialists, who gathered at this forum, discussed problems covering virtually all current directions of science, ranging from molecular biophysics to biophysics of large ecosystems.

Academician N. M. Emanuel', whose article we are publishing today, delivered one of the main papers at this congress.

The early 20th century heralded a revolution in physics which, in turn, transformed the bases of chemistry. Biological physics--biophysics of macromolecules, cells, the organism--has undergone development at an ever increasing pace in our country, as in worldwide science, since the 1950's, absorbing the enormous knowhow and traditions, methods and ideas of biology and physicochemistry.

The trends in development of biological science make it imperative for diverse specialists--biologists, physicists, chemists, mathematicians, and often physicians--to join forces under the roof of the same laboratory, within the limits of the same scientific team. Expressly such a team started to be formed at the Institute of Chemical Physics, USSR Academy of Sciences, in the mid 1950's. At that time, its tasks were referable to the biophysical and physicochemical aspects of cancer. It is difficult to name a biomedical problem that is more complex and that requires a genuinely multifaceted approach: any advancement of scientists in the field of oncology is gratefully received by all mankind. In these years, the small team of like-minded scientists was transformed into a large sector of kinetics of chemical and biological processes at the Institute of Chemical Physics, USSR Academy of Sciences.

At the present time, kinetics--science dealing with development in time and mechanisms of various natural processes--has acquired importance in biology and especially biophysics. The ideas and methodological approaches of chemical physics and kinetics found a wide area of application in the field of investigation of normal and pathological biological phenomena.

Physical chemists, biologists and physicians have established the kinetic patterns of growth of malignant tumors in man and animals. On this basis, we have proposed strictly quantitative methods of evaluating the efficacy of various antineoplastic agents, primarily chemotherapeutic ones. In a relatively short time, two antineoplastic products have been produced by the sector of kinetics of chemical and biological processes, Institute of Chemical Physics, USSR Academy of Sciences, which have enriched the armamentarium of clinical oncology.

Biology is the science of life, of living nature. The time has come when the task for biology is not only to gain knowledge about processes of vital functions and control thereof, but to develop the scientific bases for protecting living nature--the plant and animal kingdom; protecting the life of the human being has become a pressing task.

Intensive scientific and technological progress, the huge growth of industry, energy, transport, use of chemistry in agriculture have the strongest effect on the environment on the biosphere. An enormous set of measures for the control of all types of pollution of the environment of man, animals and plants is being implemented in the Soviet Union, on a national scale and over a wide front.

Comprehensive identification of the molecular mechanisms of biological effects of various physical and chemical factors on living organisms, their organs, tissues and cells, constitutes a pressing task for modern biophysics. It is important for us to understand just how these factors affect the biochemical elements of living cells--proteins, and primarily enzymes, lipids, nucleic acids.

Various forms of radiation--X-rays, ultraviolet and even visible light--are among the powerful physical factors capable of having a deleterious effect on living organisms. Radiobiology and photobiology are traditional and intensively developing branches of modern biophysics.

For many years, we have been investigating the biophysical mechanisms of radiation damage and pursuing an active search for radioprotective agents. It has been determined that the effect of radiation on biological systems is based on formation in cells of free radicals, which have heightened reactivity. Over 20 years ago, we proposed the use of nontoxic inhibitors as radioprotective agents, i.e., substances that depress development of these free-radical processes. It was established that with growth of antiradical activity of an inhibitor there is also increase in its ability to protect vitally important molecules against radiation damage. We are referring, for example, to the carrier of genetic information, the DNA macromolecule.

In the last few decades, there has been an increase in hazard of deleterious effect of ultraviolet rays from the sun on living organisms. This is related, in particular, to depletion of the ozone layer above our planet. The main cause of this is industrial pollution of the atmosphere.

As shown by our studies, the same DNA molecule is one of the targets of the deleterious effects of ultraviolet light on living cells. Mutagenicity, carcinogenicity and even lethality for some living organisms due to hard



ultraviolet radiation traversing the ozone layer are, in all probability, related expressly to its damaging effect on the genetic system. An increase in level of ultraviolet radiation amounting to only 1% leads to a 2% rise in incidence of skin cancer; ultraviolet radiation lowers plant productivity, discolors or alters the green color of leaves; hard ultraviolet radiation damages the roe and larvae of aquatic animals. The search for effective agents to protect organisms against ultraviolet radiation is becoming a pressing task.

Prolonged illumination that is too bright is capable of having a deleterious effect on sight. Of course, the "sun blindness" phenomenon has been known for a long time. However, development of technology and creation of high-power sources of both ordinary and laser radiation have put to hygiene of vision the problem of protecting the eyes against the adverse effect of visible light. Many sectors of industry, such as microelectronics, watch-making, jewelry industry, require strong illumination of the work place for long periods of time. Labor productivity is directly related to proper selection of illumination. An increase in level of illumination beyond a certain limit could, in time, lead to decline of visual functions. Of course, this lowers drastically the productivity of labor.

Situations can also arise in clinical practice when there is a possibility of damage to the retina by light in the course of diagnostic examinations or treatment, for example, during eye surgery, when the surgical field, i.e., the involved retina, is exposed for a long time to very bright light or when too frequent examinations are made of patients' eyegrounds.

In this regard, a need arises to investigate the physicochemical mechanisms of the deleterious effect of light on vision. This is needed to elaborate new safety standards for ophthalmological instruments, to set scientifically validated and hygienic standards of maximum permissible illumination at the work place and to find new means of prevention and protection against such injuries.

A study of this problem was started in our sector in the early 1970's. In essence, this constitutes development of our above-mentioned radiobiological research, i.e., extension of previously advanced principles of protection against radiation injury to photic injury. It was learned that, as in the case of radiation damage, inhibitors or antioxidants are capable of exerting a protective effect.

Chemical factors--toxic chemical compounds--present a serious hazard to living organisms. Some of them have high biological activity and are used extensively as herbicides and pesticides in agriculture, as preservatives in the food industry, as antibacterial and antineoplastic agents in medicine. For this reason, it is absolutely imperative to pursue in-depth studies of biochemical and biophysical mechanisms of effects of these chemicals on living cells in order to make effective, wise and safe use thereof. Our biophysical studies have shown that one can also use some antioxidants with success against the toxic and, in particular, carcinogenic effects of some chemical compounds.

In our country, unlike several capitalistic countries, there is exceptionally strict control of safety to man of drugs and various food additives. New,

refined biophysical research methods make it possible to conduct a more effective search for drugs for medicine and veterinary science, without allowing products with toxic side-effects to leave the laboratories.

Biophysics is a most important branch, element of physicochemical biology. The Party and government devote enormous attention to this direction of Soviet science and display much concern about its successful development in the interests of basic science and practice--medicine, agriculture and a number of sectors of industry.

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UDC: 612.014.42(048)

AMIDATION OF PROTEINS OF SOME ANIMAL ORGANS UNDER EFFECT OF MILLIMETER RANGE RADIO WAVES

Moscow BIOLOGICHESKIYE NAUKI in Russian No 12, Dec 79 p 96

[Synopsis of article by N. P. Zalyubovskaya, R. I. Kiselev and Ye. P. Prikhod'ko, filed under file No 1211-78 with the All-Union Institute of Scientific and Technical Information]

[Text] Changes were demonstrated in nitrogen metabolism of CBA mice and Wistar rats under the effect of electromagnetic radiation from waves in the millimeter range. Total, labile and firmly bound groups of proteins in the brain and liver, as well as total protein and ATP in these organs, were examined. Animals were exposed to millimeter waves at an energy flux density of  $1 \text{ mW/cm}^2$  for 10 min daily over a period of 20 days. Control animals were submitted to pseudo-irradiation. Upkeep and diet of control animals were the same.

There is a decrease in total amide groups of proteins in the liver and brain of animals, due to decline of both labile and stably bound amide groups, under the influence of mm waves. Impairment of protein amidation is manifested by a decrease in ratio between labile and firmly bound amide groups: by 26% in the liver proteins and 14% in the brain. The changes in amide group content were more marked in mouse organs than in rats, which was probably related to the specifics of radiowaves, difference in severity of radiation damage to organs of small and larger animals. There was 18% decrease in total protein content of the mouse liver and 14% decrease in the rat liver under the effect of repeated exposure to mm waves. A 12% decrease in ATP content was demonstrated in the liver and 16% decrease in the brain.

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STUDY OF CYTOGENIC ACTION OF ELECTROSTATIC FIELD

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 3, Mar 82 (manuscript received 14 Oct 81) pp 115-117

[Article by V. F. Shakarnis and Ye. V. Koval'chuk, Riga Medical Institute]

[Text] Researchers have long been interested in studying electrostatic fields (ESFs) as a factor capable of disturbing a cell's genetic apparatus. This interest is associated primarily with the fact that were it discovered that such a field has a mutagenic effect, the problem of protecting man from ESFs, which are widely encountered in industry and in the home, would be raised in a new way.

It is presently known that an ESF elicits genetic disturbances in plants [1] and insects [2].

However, this effect of an ESF has not been revealed in homeothermic animals [3,4], which may be associated with short-term exposure of the organism to the field.

Therefore the objective of our work was to study the mutagenic effect of ESFs of different intensities upon male mice of the CBA line exposed to such fields for different periods of time.

The experiments were conducted with 229 males (202 experimental and 27 control), of which 107 were exposed to a negatively charged field and 95 were exposed to a positively charged field. Moreover the experimental animals were broken down into five groups of 17-25 animals each and exposed to fields of particular intensities (50, 100, 150, 200 and 250 kv/m).

From the moment of their birth the animals were maintained in standard plastic cages on flat metal electrodes (150×30 cm). A voltage of 10-20, 30, 40 and 50 kv, monitored by a kilovoltmeter, was applied to these electrodes from a high-voltage transformer. A grounded electrode was located 20 cm above each of the charged electrodes.

Presence of a mutagenic effect produced by the ESF was determined from the frequency of chromosomal aberrations (CAs)--single and paired fragments and bridges in epithelial cells of the mouse cornea. The animals were killed 2, 3, 4 and 5

months after their birth, and the procedure suggested by Tsapygina and Yatsenko (1976) was employed. [5].

The experiment did not reveal significant differences in the ratio of CA frequencies between the studied field intensities. Consequently these variants were united, and the groups were differentiated only in relation to the sign of the charge. The obtained data are shown in Table 1, from which we can see that the frequency of CAs does not change in response to the action of the field.

Concurrently we studied the field's influence upon the mitotic index (MI) of epithelial cells of the mouse cornea using Tsapygina's method (1971) [6].

In this case a positively charged field increased the MI by 52 percent while a negatively charged field decreased it by 49 percent. The latter is similar to the action of a low frequency electric field upon cells of the corneal epithelium of white mice [7] and on a culture of human fibroblast-like cells [8].

Table 2 shows the results of our study of the MIs of corneal epithelial cells exposed to positively charged ESFs of different intensities. The maximum MI,  $1.73 \pm 0.18$  percent, was observed at an ESF intensity of 200 kv/m. However, this value did not differ significantly from the MI values recorded for intensities of 150 and 250 kv/m ( $P > 0.05$ ). If we wish to establish the intensity of an ESF which would maximally increase the MI, we would need to increase the sample volume.

The obtained MIs for epithelial cells of the mouse cornea exposed to a positively charged ESF are 39, 49, 54, 77 and 45 percent greater (in order of increasing ESF intensity) than the MIs for the corneal epithelial cells of control animals. This difference was statistically significant.

The results of studying the MIs of animal cells exposed to different intensities of negatively charged ESFs are shown in Table 3. Here the minimum MIs occurred with ESF intensities of 150 and 200 kv/m.

The MIs of mouse corneal epithelium exposed to a negatively charged ESF are 38, 45, 56, 56 and 48 percent lower (in order of increasing ESF intensity) than the MIs for the corneal epithelial cells of control mice.

Thus this analysis of the cytogenic action of ESFs showed that this physical factor does not cause disturbances in epithelial cells of the mouse cornea. The differentiated action of differently charged ESFs upon the MI is similar to the action of ESFs upon the life span of animals [9,10], which does not exclude the possibility of a mutual relationship between proliferative activity and aging in the cell.

#### Conclusions

1. An electrostatic field of the intensities employed (50-250 kv/m) does not change the frequency of chromosomal aberrations in epithelial cells of the cornea of male mice from the CBA line.

Table 1. Action of an Electrostatic Field on Cytogenic Activity of Epithelial Cells of the Mouse Cornea

(1) Вариант опыта	(2)		(3)		(4)	
	Число животных	МИ, %	МИ, %	ХА, %	ХА, %	
(5) Контроль (I) ЭСП	27	0,98±0,15		1,20±0,16		
(6) положительного заряда (II) ЭСП	95	1,49±0,05		1,16±0,06		
(7) отрицательного заряда (III) $P_{I-II}$ $P_{I-III}$ $P_{II-III}$	107	0,50±0,02		1,19±0,09		
			<0,01			>0,05
			<0,01			>0,05
			<0,001			>0,05

Table 2. Action of a Positively Charged Electrostatic Field on the Mitotic Index of Epithelial Cells of the Mouse Cornea

(1) Вариант опыта (напряженность ЭСП, кВ/м)	(2)		(3)	
	Число животных	МИ, %	МИ, %	P
(5) Контроль	27	0,98±0,15		
50	20	1,36±0,09		<0,05
100	20	1,46±0,13		<0,05
150	17	1,51±0,06		<0,01
200	18	1,73±0,18		<0,01
250	20	1,42±0,07		<0,05

Table 3. Action of a Negatively Charged Electrostatic Field on the Mitotic Index of Epithelial Cells of the Mouse Cornea

(1) Вариант опыта (напряженность ЭСП, кВ/м)	(2)		(3)	
	Число животных	МИ, %	МИ, %	P
(5) Контроль	27	0,98±0,15		
50	20	0,61±0,04		<0,05
100	20	0,54±0,03		<0,01
150	25	0,43±0,04		<0,001
200	21	0,44±0,02		<0,001
250	21	0,51±0,01		<0,01

Key:

- |                       |                          |
|-----------------------|--------------------------|
| 1. Experiment variant | 5. Control               |
| 2. Number of animals  | 6. Positive Charge       |
| 3. MI                 | 7. Negative Charge       |
| 4. CA                 | 8. (ESF intensity, kv/m) |

2. An electrostatic field has an influence on the mitotic activity of epithelial cells of the mouse cornea. In this case a positively charged field increases mitotic activity while a negatively charged field decreases it.

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POSSIBILITIES FOR RAISING THERAPEUTIC EFFECT OF MAGNETOTHERAPY

Riga IZVESTIYA AKADEMII NAUK LATVIYSKOY SSR in Russian No 9, Sep 82 (manuscript received 26 Aug 81) pp 118-121

[Article by M. S. Bruvele, Latvian SSR Scientific Research Institute of Traumatology and Orthopedics]

[Text] The period of cautious introduction of magnetotherapy into clinical practice following experimental research has come to an end. The suitability of using this new physical factor has been demonstrated, and procedures have been developed for treating patients with different pathologies: vascular diseases of the brain and limbs, bone fractures, cerebrocranial injuries, the consequences of burns (contractures and scars), osteochondrosis, prevention of thrombus formation following injury and application of sutures, and many other diseases.

The attained results are evaluated by the authors as good and satisfactory in relation to vascular diseases of the limbs and pelvis among 65-97 percent of patients, in the presence of obliterative diseases of limb vessels among 85 percent of patients and in the presence of parkinsonism in 78-82 percent of patients. In the presence of fractures, reduced swelling and restored circulation are observed among 97 percent of treated patients [2,4,6,11].

The next stage of our work required us to answer the following question: Is there a possibility for raising the effectiveness of magnetotherapy?

Biotropic parameters of magnetotherapeutic procedures are known to differ individually, in the same way that individual reactions of the nervous system differ [9,10]. In this connection the treatment method must be selected not only in application to the disease, depending on its form and stage, but also with a consideration for the body's individual features [2,6].

A constant magnetic field (CMF) is used in our clinic to treat patients with disturbances of cerebral circulation, parkinsonism, traumatic injuries of bones and soft tissues of the limbs, osteochondrosis and other pathologies. The procedures used in application of CMFs differ in relation to each kind of disease in terms of the parameters of the magnetic field, exposure time and overall length of the course of treatment. However, in all cases the influence of the CMF upon the body is not limited to just the afflicted organ or system; instead, there is an indirect reaction throughout the whole body.

We analyzed the results of therapy, changes occurring in overall condition during the time of therapy and changes in the peripheral blood picture and the prothrombin index of 102 patients (62 with parkinsonism, 23 with keloid scars, 17 with long-persisting lymphostasis and stable edema of limbs following injury). The ages of the patients were 30-40 years for 16, 41-50 years for 57, 51-60 years for 21 and over 60 years for 2; 47 percent were women and 53 percent were men.

Changes in the prothrombin index, taking the form of a 20-30 percent reduction, were observed among most of the patients (statistically significant at  $p < 0.001$ ) on the 2d-5th days of treatment. Changes in the peripheral blood picture were noted in the presence of heightened sensitivity to the CMF after 7-10 days or toward the end of the course of treatment [3]. However, we believe that these indicators do not have prognostic significance to the proposed effectiveness of the applied course of magnetotherapy.

Most patients undergoing magnetotherapy exhibit sensory reactions to the CMF as well as subjective and objective changes in overall condition taking the form of weakness, sluggishness, a heavy feeling in the limbs, on occasion headaches and dizziness, and so on. Identical nonspecific sensations were observed in response to CMF treatment of other diseases. These sensations were evaluated by the authors as side reactions to magnetotherapy [7,10].

What we find interesting is the fact that the described manifestations are noted in the patients within one of the first days of treatment (5th-7th), they last only 1-2 days, they are easily tolerated by patients, and as a rule they go away after the next CMF procedure without any additional symptomatic therapy. Change in overall condition occurs in the direction of an improvement without side effects of the CMF in a small proportion of the patients. This change is also observed in the 1st-5th days of therapy and remains stable following the course of magnetotherapy. The form and time of manifestation of changes in overall condition in response to a CMF are individual for each patient, but they differ little in either the first or repeat courses of therapy. These phenomena were explained by us as the body's reaction to magnetotherapy.

The observed patients were divided into the following groups depending on the time of arising of changes in overall condition:

- group 1 (with an early reaction--following one or two treatments)--52 persons,
- group 2 (with a middle reaction--following three or four treatments)--24 persons,
- group 3 (with a late reaction--following five treatments)--17 persons,
- group 4 (without a pronounced reaction to CMFs)--9 persons.

Sensory reactions to CMFs were expressed most frequently among patients in group 1, but they were not observed among patients in group 4.

Figure 1 shows the results of magnetotherapy in relation to the different groups of patients. The greatest therapeutic impact was achieved among patients in

group 1. The corresponding effects in the other groups were 92.3, 91.7 and 70.6 percent, and two out of nine patients. Treatment was ineffective among 17.6 percent of the 102 patients.

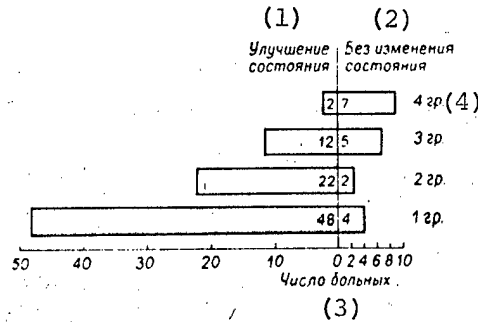


Figure 1. Results of Magnetotherapy in Groups of Patients Exhibiting Different Times of Reaction to a Constant Magnetic Field

Key:

- 1. Improvement in condition
- 2. No change in condition
- 3. Number of patients
- 4. Group

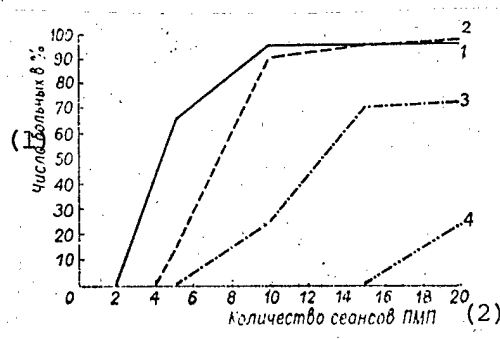


Figure 2. Dependence of Effectiveness of Magnetotherapy on Time of Reaction to Constant Magnetic Field: continuous line--improvement in condition of patients of group 1; broken line--group 2; dot-dash line--group 3; dot-dot-dash line--group 4.

Key:

- 1. Number of patients, percent
- 2. Number of CMF treatments

It should be noted that magnetotherapy was performed on all of these patients by the procedures indicated for the given diseases. Here and subsequently, we will be discussing not new procedures but ones individually adjusted in application to each individual patient.

A unique dependence, shown graphically in Figure 2, was revealed by an analysis of the effectiveness of CMF therapy and the times of manifestation of a reaction.

In group 1, disease symptoms decreased significantly in 65 percent of the treated patients after just five CMF treatments. A maximum of 92.3 percent was attained at the end of 10 treatments.

In group 2, a therapeutic effect was noted among 15 percent of the patients after the first five exposures, and among 87 percent of the treated patients after 10. This figure did not change significantly with further treatments.

An improvement in condition was observed after 10 treatments in 25 percent of the patients of group 3--that is, after a course of treatment of average length; however, this number did rise to 70.6 percent following 15 CMF treatments.

In group 4 a positive therapeutic result was noted following 15 and 17 treatments, and it was observed in only two out of nine patients, with no change occurring in response to further treatment.

The therapeutic effect of the CMF and manifestation of the reaction to it are based on change in microcirculation within all or part of the sick organism. Changes in the vascular channel grow in magnitude as the time of exposure to the magnetic field rises [1,5]. Therefore by promoting an early reaction to the CMF, which can be done by changing the field parameters and exposure time, we can individually select the biotropic parameters of magnetotherapeutic influence to achieve an optimum therapeutic effect from the CMF.

In subsequent magnetotherapy we tried to cause a reaction in the patients not later than after four treatments. We were able to do so by increasing the intensity of the magnetic field by 50-70 oersted and lengthening the treatment session. Thus when patients exhibited an unpronounced reaction following three CMF treatments, a 50-60 oersted increase in field intensity elicited a response following the next one or two treatments (after a total of four to five treatments from the beginning of therapy), and just after 10 treatments an improvement in condition was observed among 90-95 percent of these patients, such that lengthening of the course of treatment was not required. Patients exhibiting an unpronounced reaction after two or three treatments with the intensified magnetic field (after a total of four to five treatments from the beginning of therapy) were subjected to a one-time CMF exposure lengthened by 5-10 minutes, though the exposure time was not allowed to exceed 20 minutes in any one treatment. For such patients, the course of CMF therapy was lengthened to 15 treatments.

It should be noted in conclusion that such individual selection of biotropic parameters and the magnetotherapy conditions for each patient raised the effectiveness of CMF therapy to 93-95 percent of all treated patients.

#### Conclusions

1. Precise determination of the moment at which a patient reacts to a CMF is an aid in selecting individualized biotropic parameters for the magnetic field and the magnetotherapy conditions, assuming use of the procedures developed for the given pathology.

2. A certain dependence exists between the time of manifestation of a patient's reaction to the CMF and the therapeutic effect of the magnetotherapy. The CMF was most effective in patients exhibiting a pronounced early reaction (after one to three treatments).

3. The therapeutic effect of magnetotherapy can be increased during treatment by changing the parameters of the magnetic field and the treatment conditions, assuming that the reaction time of each patient to the CMF is determined and the quality of the reaction is evaluated individually.

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11004

CSO: 1840/26

## MARINE MAMMALS

### NEW DISCOVERY IN CETACEAN HYDRODYNAMICS

Moscow VERCHERNYAYA MOSKVA in Russian 4 Nov 82 p 2

[Article: "Why a Whale Swims Rapidly"]

[Text] Whales and dolphins overcome great distances with enviable speed.

Why are these animals easily able to overtake boats and fish? This question has long interested specialists. Now the secret of cetacean swimming has been solved. Research resulting in the scientific discovery was conducted both under natural conditions and in laboratories. Scientists from Moscow, Leningrad and Kiev participated in the research.

The authors of the discovery--N. E. Sokolov, V. V. Babenko, L. F. Kozlov, S. V. Pershin, A. G. Tomilin and O. B. Chernyshev--determined that during the active swimming of a whale or dolphin all the animal's cutaneous layers interact with the circumfluent stream such that the swimming resistance is reduced. Highly sensitive cutaneous receptors pick up the smallest changes in the stream characteristics, and the mechanical properties of the skin, for example its elasticity, are immediately adjusted automatically. As a result turbulences in the incident stream are eliminated, and the swimming velocity increases.

The discovery has introduced radical changes to the understanding of the biohydrodynamic interaction of cetacean skin with a stream of water and has promoted the further development of hydrobiology.

The scientists' discovery was recorded today at the USSR State Committee for Inventions and Discoveries.

9942

CSO: 1840/118

## ANATOMICAL STRUCTURE AND TOPOGRAPHY OF THE BOTTLE-NOSED DOLPHIN STOMACH

Kiev VESTNIK ZOOLOGII in Russian No 5, Sep-Oct 82 (manuscript received 2 Apr 80) pp 70-75

[Article by V. Ya. Lukhanin, Institute of Zoology imeni I. I. Shmal'gauzen, Ukrainian SSR Academy of Sciences]

[Text] The available published data indicate that the cetacean stomach is complex and multichambered, and that it contains from 3 to 13 divisions in different species. Thus there are three divisions in the stomach of the sperm whale, the pilot whale, the common dolphin, the white-faced dolphin, the blue whale, the beak-nosed dolphin and the bottle-nosed dolphin [1,2,4,5,10]. The white whale is said to have from three to five divisions [3,4,6,9 etc.]. A number of investigators [5,7-9] point out that the first division of the stomach is an esophageal division, and that the second and third divisions are glandular.

This communication presents data on the anatomical structure and topography of different gastric divisions of the Black Seabottle-nosed dolphin (*Tursiops truncatus ponticus* B.). Material from 12 specimens was used in the work. N. I. Pirogov's method was used in cutting up the carcasses, and V. P. Vorob'yev's method was used to prepare the samples.

As with other cetaceans, the bottle-nosed dolphin has a complex, multichambered stomach (Figure 1, 4) [Figure 1 not reproduced] located in the anterodorsal portion of the abdominal cavity, to the left of the midline. It can be distinguished into a vestibule, a first division or forestomach, a second division or the stomach itself, and a third or pyloric division, which communicates with the duodenum. The first and second divisions are the largest.

The vestibule (vestibulum s. antrum ventriculi) is located between the esophagus and the first division. The mucous membrane of the vestibule differs from the mucosa of the first division in the shape and dimensions of the folds. The vestibule joins the esophagus not only to the first division but also to the second, and it additionally provides communication between the first and second divisions of the stomach. Therefore it has three openings. The first--



the ostium oesophageo-vestibularis, joins the esophagus to the vestibule. Inasmuch as this opening joins the esophagus not only to the vestibule but also to the rest of the stomach, it would be proper to call it a cardiac opening (ostium cardiacum). The second--the ostium vestibulo-proventricularis--provides communication between the vestibule and the first division (the forestomach). The third--the ostium vestibulo-fundalis--joins the vestibule to the second division. Of interest is the fact that the entrance to the second division is almost directly adjacent to the cardiac opening, while the entrance to the first division is located a little farther away, on the caudal end of the vestibule.

Externally the vestibule is distinguishable owing to presence of furrows that separate it from adjacent divisions. In addition, in contrast to the free surface of the first and second divisions, that of the vestibule fuses with the overlying diaphragm. On the anterior side the vestibule has a bulge that wedges itself between the final segment of the esophagus and the second division (Figure 3). The entrance to the second division, which is covered over by folds of the mucosa, is located on the left wall of this bulge, which is common to the vestibule and the second division or the septum between them. The cranial bulge on the first division lies above and to the left of the vestibule (Figure 3). Caudally from there, the second division is pushed away from the vestibule by the enlarging first division. The adjoining walls of the first division and the vestibule fuse together on coming into contact (Figure 4). Even further caudad this common wall grows thinner, and a connecting hole forms between the vestibule and the first division. Beginning at this point the cavity of the vestibule transforms into a channel (Figure 5). Gradually the vestibule disappears, and its right wall turns into the right (medial) wall of the posterior part of the first division.

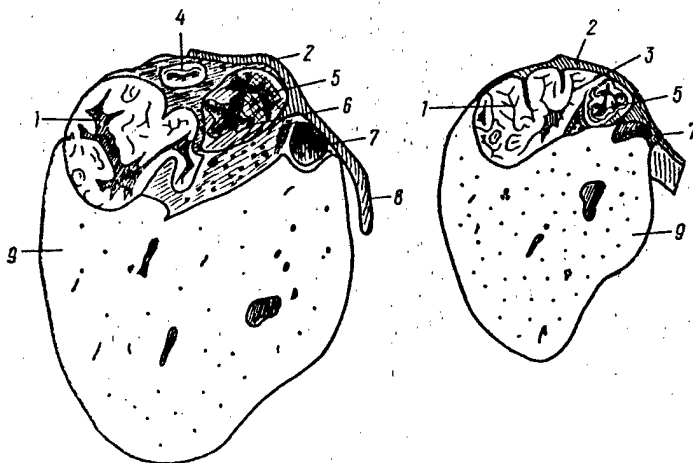


Figure 3. Transverse Sections of the Dolphin Stomach at Different Levels (Back View, Drawn From a Preparation): 1--Second gastric division; 2--diaphragm; 3--anterior bulge of vestibule; 4--anterior blind bulge of first division; 5--esophagus at the boundary between it and the vestibule; 6--gastric vestibule; 7--posterior vena cava; 8--free portion of diaphragm; 9--liver.

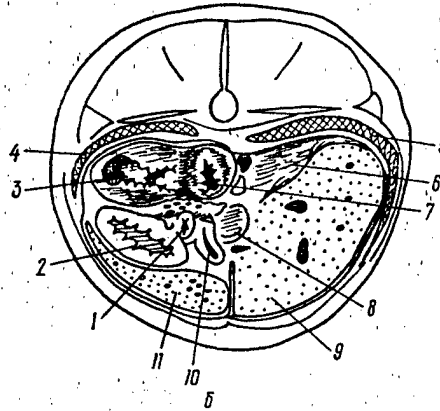


Figure 4. Dolphin Stomach as Observed Following Frontal Dissection of Torso (Back View, *a*--Photograph of Preparation [Figure 4*a* not reproduced], *b*--Drawing of Preparation): 1--Third gastric division; 2--second division; 3--cranial blind bulge of first division; 4--left lung; 5--right lung; 6--diaphragm; 7--gastric vestibule; 8--lymphatic crest; 9--right lobe of liver; 10--duodenum; 11--left lobe of liver.

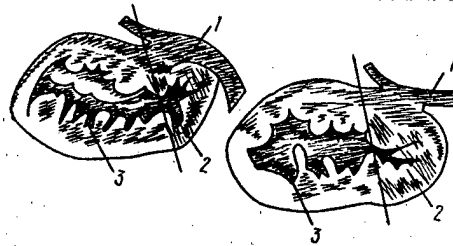


Figure 5. Vestibule and First Gastric Division of the Dolphin at the Level of the Connecting Opening Between Them (Back View, Drawing From a Preparation; Left--More-Cranial Section): 1--Diaphragm fused with vestibule wall; 2--vestibule; 3--first division.

The first or esophageal division (*ventriculum oesophageous, s. pars oesophagea ventriculi*), named so for its similarity to the corresponding section of a single-chambered stomach of the mixed esophageal-intestinal type, or the forestomach (*proventriculus*) as it is otherwise called, is a powerful muscle formation oriented on a craniocaudal axis and enveloped by a strong connective tissue sheath (Figure 1). The inside surface of the forestomach is lined by mucosal folds of varying depths (Figure 4) covered by a keratinized multilayered flat epithelium. The latter imparts a whitish hue to this division of the mucous membrane.

The first division is blind toward the front and toward the back. The top of the anterior bulge of the first division, as was indicated earlier, lies against the place where the second division and the vestibule join. (Figure 3). A little

further back this part of the first division crowds the second division away from the vestibule. In this case the right wall of the interior part of the first division connects to and then fuses with the left wall of the vestibule (Figure 4), and a connecting opening forms within this wall (Figure 5), almost in the middle of the medial wall of the first division. The latter has a single communicating passage that serves as both an entrance and an exit.

As with the second, the first division is covered by the diaphragm, but it does not fuse with it, in distinction from the ventral portion of the esophagus and the gastric vestibule.

The first division and the overlying diaphragm border on the lower surface of the posterior margin of the left lung and the free surface of the hypaxial musculature originating here (Figure 4). The anterior portion of the bottom of the first division lies against the dorsal surface of the second division and the vestibule at their junction (Figure 3). Further back, the first division rests against the dorsal surface of the second and pyloric divisions of the stomach and the cranial portion of the left lobe of the pancreas (Figure 4). Even further caudad the bottom of the first division lies against the posterior surface of the second division and the posterior surface of the left lobe of the liver, leaving an indentation upon the latter (Figure 7). Mesially, the anterior portion of the first division lies against the vestibule and then against the lateral surface of the left lobe of the pancreas and even further caudad it rests against the left surface of the spleen. The latter is connected rather substantially to the ventromesial surface of the first gastric division. The rear of the first division borders upon loops of the small intestine, while laterally this division contacts with the inner surface of the lateral portion of the abdominal wall.

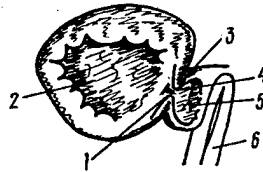


Figure 6. Second and Third Divisions of the Dolphin Stomach at the Level of the Connecting Opening (Back View, Drawn From a Preparation): 1--Pylorofundal ostium; 2--second division; 3--pylorofundal sphincter; 4--third division; 5--pylorus; 6--duodenum.

The second division is located ventrad and laterad to the first, and it is separated from the latter by a fissure (Figures 3, 4). This permits both the first and second division to move freely relative to one another as the stomach is filled with food or as it is emptied.

The second or fundal division (*ventriculum fundalis*, s. *pars fundalis ventriculi*) named so because of its similarity with the corresponding glandular portion

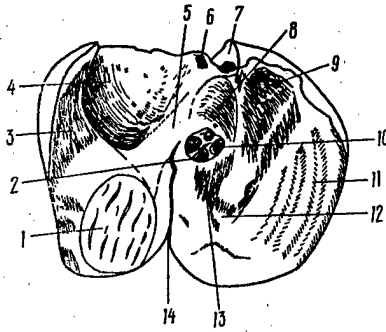


Figure 7. Liver (Back View, Drawn From a Preparation): Indentations caused by organs and the following organs are visible: 1,11--Loop of small intestine; 3--caudal part of first gastric division; 4--second division; 5--duodenal cap; 6--esophagus; 8--splenic appendix; 9--intestinal ampule; 12--lower horizontal part of duodenum; 13--pancreas; 2--bile duct; 7--superior longitudinal fissure; 10--vessels of the portal fissure; 14--inferior sagittal fissure.

of the single-chambered stomach of the mixed esophageal-intestinal type, is the stomach specifically (*ventriculum proprium*). It begins at the left lateral wall of the vestibule, and it terminates near this point, undergoing a transition into the pyloric division (Figures 1, 3, 7). The entrance to the second division communicates with the vestibule (Figure 3), while the exit communicates with the pyloric division (Figure 7). Both openings are located next to each other in the mesial wall of the second division. The second division, which bulges left of the first in the form of a slightly flattened sphere of rather large size, occupies considerable volume in the abdominal cavity. It is situated in its anterodorsal left part closer to the midline.

The second division is embraced by the left lobe of the liver anteriorly, to the left and from below, forming a large impression within it (Figures 2, 7) [Figure 2 not reproduced]. Dorsally, the cranial portion of the second division is covered by the diaphragm, which borders at that point with the lower surface of the rear portion of the left lung. Caudally and dorsally, the second division rests against the ventral surface of the first division (Figure 4). Anteriorly and mesially this division borders on the terminal section of the esophagus, penetrating through the diaphragm (Figure 2), and further caudally it borders on the anterior bulge of the vestibule (Figure 3). Within a small area this wall becomes common to the vestibule and the second division. The entrance to the second division (the *ostium vestibulo-fundalis*) is located in it.

Also located here is a closure consisting of mucosal folds of the vestibule and second division and a muscular ring at the base of these folds consisting of fibers of a muscular sheath.

Caudad, the second division is forced somewhat left and ventrally by the cranial portion of the second division which wedges in between it and the vestibule (Figure 3). Further caudad the mutual arrangement of the first and second

divisions changes again, and now the posterior surface of the second division rests against the bottom of the first. The pyloric division is located mesially at this point (Figure 4). There is a sphincter in the wall between them, encompassing the connecting passage (Figure 6). Part of the left lobe of the pancreas also rests against the second division on the right.

The wall of the second division is just as thick as that of the first division; however, the ratio of the thicknesses of the individual layers is somewhat different. The mucosa forms large folds separated by deep furrows. Abundant vascularization imparts a wine color to the mucosa. The muscle sheath is weaker than in the forestomach.

The third or pyloric division (ventriculum piloricum, s. pars pilorica ventriculi) has the smallest volume (Figures 4, 6), and it is located on the lower portion of the mesial wall of the second division. The first division and part of the pancreas rest on its dorsal surface. The duodenal cap (bulbus duodenum) fuses with it mesially. There is a septum containing a sphincter (m. sphincter pylorico-fundalis) between the pyloric and second divisions. This sphincter encompasses the pylorofundal ostium. The same sort of structure is located in the wall separating the pyloric division from the duodenal cap. However, it is weakly expressed, and it is not very distinguishable from the sphincter located in the septum between the second and pyloric divisions. The stomach exit--the pylorus--is located here. The pyloric division is readily evident from the outside owing to presence of the sulcus pylorico-fundalis and the sulcus pylorico-duodenalis, which delimit it from neighboring formations of the digestive apparatus.

The mucosa of the pyloric division somewhat recalls the mucosa of the second division. Its folding is less pronounced, and as with the thickness of the entire wall of this division, its thickness is significantly less than that of the second division. A paler hue attests to its relatively weaker vascularization.

Thus the dolphin stomach consists of three basic divisions. The first division is a formation possessing some features typical of the esophagus and others typical of the stomach. Thus in structural terms the wall of the first division is similar to the wall of the esophagus, but its general appearance and some of its functions provide the grounds for treating this structure as part of the stomach. For example despite absence of gastric glands in its wall, food may be detained here for a rather long time, being subjected to processing in this case--maceration in particular. The second division is the main subdivision of the complex multichambered stomach, or it may be referred to as the stomach specifically, inasmuch as all of the glandular apparatus of the stomach is concentrated here, and all of the basic processes of food digestion proceed here. In terms of the nature of its mucosa, the third division somewhat recalls the second, occupying an intermediate position between the latter and the duodenum. Besides these divisions, a special structure--the gastric vestibule, which possesses typical characteristics making it different from adjacent subdivisions--is well expressed.

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11004

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## DATA ON COURSE AND BRANCHING OF VAGUS NERVE IN GASTRIC CHAMBERS OF BLACK SEA DOLPHINS

Kiev VESTNIK ZOOLOGII in Russian No 5, Sep-Oct 82 (manuscript received 29 Jun 82) pp 75-78

[Article by V. L. Gulo, M. V. Veselovskiy and N. N. Morozova, Institute of Zoology imeni I. I. Shmal'gauzen, Ukrainian SSR Academy of Sciences, and All-Union Scientific Research Institute of Fisheries and Oceanography, USSR Ministry of Fish Industry]

[Text] The literature contains considerable information on innervation of visceral organs of man and some animals [1,2, 4-6, etc.]. Research on this subject has been much weaker in relation to marine mammals [3].

Materials and Methods: Black Sea dolphins served as the objects of our research: the bottle-nosed dolphin (*Tursiops truncatus*)--six specimens, the common dolphin (*Delphinus delphis*)--four specimens, the Black Sea common porpoise (*Phocaena phocaena*)--seven specimens. The following procedures were employed: macropreparation of fresh and fixed objects, V. P. Vorob'yev's macroscopic and microscopic methods etc.

In Black Sea dolphins the branches of the right and left vagus nerves form ventral and dorsal esophageal trunks in the thoracic cavity. As such trunks, the bulk of the fibers of the vagus nerves penetrate into the abdominal cavity. Moreover a number of branches, the quantity of which is highly variable, penetrate into the abdominal cavity independently, not in association with the ventral and dorsal trunks.

The bottle-nosed dolphin (Figure 1 [not reproduced]): In the abdominal cavity the ventral esophageal trunk begins to branch in a loose pattern as it passes over the ventral surface of the abdominal segment of the esophagus. In this case as a rule two or three large branches with a diameter up to 6 mm and a number of small branches--from 6 to 12 with a diameter from 0.5 to 1 mm--form. These branches are located on the ventral surface of the gastric vestibule. Throughout their entire length the branches exchange numerous bridges and spread to the anterior and main division of the stomach. The branches of the ventral trunk of the vagus nerves and their bridges form the ventral vestibulo-gastric plexus. The latter is located on the ventral surface of the vestibule

and on the anterior and lateral surfaces of the anterior division of the stomach. As a rule the plexus contains two or three rounded or irregular polygonal nerve ganglia about 4×5 mm in size. The ganglia are usually located on the ventral surface of the vestibule and at the boundary between the vestibule and the anterior division. A number of branches penetrating into the abdominal cavity apart from the ventral esophageal trunk form the plexus. Spreading to the above-indicated surfaces of the vestibule and the anterior and main divisions, the branches of the plexus gradually grow thinner and penetrate into the walls of these organs. Moreover there are branches on the right and left lateral surfaces of the vestibule that subsequently pass toward the cranial ganglia of the solar plexus. Branches of the ventral vestibulogastric plexus participate in innervation of the pyloric division, and they come in contact with branches of the splenic plexus, which lies on the splenic artery.

Dividing into a number of branches on the dorsal surface of the vestibule, the dorsal esophageal trunk forms a dorsal vestibulogastric plexus. It is located on the dorsal and partially on the lateral surface of the vestibule. The vagus nerve branches penetrating into the abdominal cavity independently, not in association with the dorsal esophageal trunk, form the plexus. The dorsal plexus connects by numerous branches to the ventral vestibulogastric plexus. As a rule the plexus contains one or two nerve ganglia 2×3 mm in size. They usually lie on the lateral wall on the vestibule. Both the ventral and dorsal plexuses supply a number of branches to ganglia of the sacral plexus.

The common dolphin: In the abdominal cavity the ventral esophageal trunk divides into a number of branches that pass over the ventral surface of first the esophagus and then the vestibule. The branches exchange numerous bridges between themselves and form a ventral vestibulogastric plexus. (Figure 2a [Figure 2 not reproduced]). It lies on the ventral surface of the vestibule and on the anterior and lateral surfaces of the anterior and main division of the stomach. On the ventral surface of the vestibule the plexus has the form of a fine network which may contain one or two small ganglia. The same sort of ganglia may be found on the lateral wall of the anterior and main divisions. Branches of the vagus nerves penetrating into the abdominal cavity independently, not in association with the ventral esophageal trunk, may participate in formation of the plexus. The branches of the plexus participate in the pyloric division's innervation.

In the abdominal cavity the dorsal esophageal trunk forms the dorsal vestibulogastric plexus (Figure 2b), which is located on the dorsal and partially on the lateral surfaces of the vestibule and the anterior division of the stomach. In the initial section of the plexus, which occupies the most cranial location, there are one or two nerve ganglia of irregular shape. These ganglia give off branches which enter into the dorsal plexus and one or two branches that pass to the cranial ganglia of the sacral plexus. The latter communicates with the ventral vestibulogastric plexus and with the splenic plexus by numerous bridges.

The common porpoise: As in the bottle-nosed and common dolphins, the esophageal trunks of the vagus nerves of the common porpoise form a ventral and a dorsal vestibuloesophageal plexus.

The ventral esophageal plexus (Figure 2c) lies on the ventral surface of the vestibule and on the anterior and lateral surfaces of the abdominal division.



In addition to branches of the corresponding esophageal trunk, branches penetrating into the abdominal cavity on their own participate in formation of the plexus. Passing over the right lateral surface of the main division, the branches of the plexus subsequently supply ganglia of the solar plexus. Similar branches are located on the left lateral surface of the vestibule and the anterior division of the stomach. Branches of the ventral esophageal plexus take part in the innervation of the pyloric division of the stomach. As a rule there are one to three small rounded ganglia with a diameter of 2-3 mm in the plexus.

The dorsal esophageal plexus (Figure 2*d*) is formed by branches of the dorsal esophageal trunk, and it lies on the dorsal surface of the vestibule. Usually the plexus is represented by three or four branches with thin bridges between them. In most cases there is a nerve ganglion with a diameter of 2-3 mm where branching of the dorsal esophageal trunk originates. In some cases it was absent, and the plexus was represented by two branches with few bridges. Branches of the plexus supply the dorsal and lateral surfaces of the vestibule and the anterior division of the stomach. The dorsal plexus communicates with ganglia of the solar plexus.

Thus, taking the form of a ventral and a dorsal esophageal trunk, the vagus nerves form two gastric plexuses in the abdominal cavity of Black Sea dolphins--dorsal and ventral vestibulogastric plexuses. Except for fully natural species-specific differences, this general topography of the vagus nerves in the abdominal cavity is typical of the Black Sea dolphins, and in general it is similar to that of other mammals. In particular we can note the similarity of the plexuses described above to the "vestibulocitracial" and "interreticulo-omasal" plexuses described by Mindubayev [6] in some domestic and wild animals--representatives of order Artiodactyla.

Extensive innervation of the vestibule and the anterior and main divisions--areas exhibiting pronounced peristaltic and secretory activity--should also be noted in the Black Sea dolphins.

#### FIGURE CAPTIONS

Figure 1. Dorsal and Ventral Vestibulogastric Plexus of the Bottle-Nosed Dolphin: 1--Vestibule; 2--main division; 3--ventral esophageal trunk; 4--dorsal vestibulogastric plexus; 5--ventral vestibulogastric plexus; 6--nerve ganglia; 7--branch supplying solar plexus.

Figure 2. Branching of the Vagus Nerve on Gastric Chambers of Black Sea Dolphins: *a*--Ventral vestibulogastric plexus of the common dolphin; *b*--dorsal vestibulogastric plexus of the common dolphin; *c*--ventral vestibulogastric plexus of the common porpoise; *d*--dorsal vestibulogastric plexus of the common porpoise; 1--vestibule; 2--main division; 3--anterior division; 4--ventral esophageal trunk; 5--dorsal esophageal trunk; 6--nerve ganglia; 7--branch supplying solar plexus; 8--branches of the ventral vestibulogastric plexus; 9--branches of the dorsal vestibulogastric plexus.

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## MEDICINE

### ELECTRONIC DIAGNOSIS

Moscow PRAVDA in Russian 26 Dec 82 p 8

[Article by PRAVDA nonstaff correspondent I. Sergeyeva, Zaporozh'ye]

[Text] An automated consultative-diagnostic polyclinic has commenced operation in Zaporozh'ye at the Kommunar Automobile Factory. Here, special machines conduct the examination. Whereas, before just one worker required up to five days for a prophactic examination, he now requires two hours.

...The novelty begins with registration. Here, the patient's questionnaire data are not written down but with the help of a display are entered into a computer. This takes about a minute. In the next room you are received by ...no, not by a physician, but again by a machine. The nurse instructor explains how to use the device, turns it on, composes a registration number and the conversation begins. Questions are asked on the screen and you respond.

About 2,000 of the most diverse questions are incorporated into the computer memory. The entire range of illnesses is anticipated. But each visitor is asked questions only as applied to his complaints. The computer "questions" politely, patiently. If something is in doubt, it narrows the questions and requires details. It does not hurry. The conversation can last half an hour.

Then the data of the analyses, investigations and an objective medical diagnosis will be automatically entered onto a card. And all this without pencil or pen.

And thus, the automated system is in operation--the result of the creative work of engineers and medical scientists. The group of enthusiasts is led by A. Sitnik, candidate of technical sciences and head of the central laboratory of the Zaporozh'ye Automobile Factory. A. Goncharenko took a most active part in the development of the medical-diagnostics center; he is now the polyclinic's head physician. The programs and equipment were developed and introduced by the factory engineers in cooperation with physicians. Considerable assistance was rendered by scientists of the Zaporozh'ye Institute for the Advanced Training of Physicians.

"Our center," says group director A. Sitnik, "does not simply determine the state of health of the patient but also analyzes the obtained data and makes a preliminary conclusion. It thus aids the physician in establishing a final diagnosis."

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CSO: 1840/133

THERAPEUTIC EFFICACY OF DIETHYXIME IN CASES OF POISONING BY CARBAMINE PESTICIDES WITH ANTICHOLINESTERASE ACTION

Moscow FARMAKOLOGIYA I TOKSIKOLOGIYA in Russian Vol 45, No 4, Jul-Aug 82  
(manuscript received 3 Jun 81) pp 61-64

[Article by N. V. Kokshareva, Laboratory of Experimental Therapy (headed by I. G. Mizyukova, doctor of medical sciences), All-Union Scientific Research Institute of Hygiene and Toxicology of Pesticides, Polymers and Plastics, Kiev]

[Text] Treatment of poisoning by derivatives of carbamic acids is based on use of cholinolytic agents (atropine sulfate) and symptomatic agents; it is not desirable to use cholinesterase reactivators (CR) with peripheral type of action, such as dipyroxime or 2-PAM. In view of the fact that the new CR, diethyxime, which was synthesized in our institute, has marked central (N. V. Kokshareva et al., 1977) and cholinolytic (N. V. Kokshareva and V. Ye. Krivenchuk, 1978) action, it was interesting to test its efficacy in animals poisoned with some carbamine pesticides used in the national economy: carbofuran (2,3-dihydro-2,2-dimethyl-7-benzofuranyl-N-methylcarbamate), pyrimor [2-dimethyl-amino-5,6-dimethylpyrimidyl-4(N,N-dimethylcarbamate)], elokron [2-1,3-dioxalan-2yl(phenyl-N-methylcarbamate)] and kroneton (2-ethyl-mercaptopomethyl-phenyl-N-methylcarbamate). For comparison purposes, we tested atropine and the CR, dipyroxime.

Methods

Experiments were conducted on 420 mongrel white rats weighing 180-230 g. There were 6-8 animals per experimental group. Carbofuran, pyrimor, elokron, kroneton were given in the form of 0.5-10% aqueous solutions intragastrically, using a wide range of doses (from 4 to 500 mg/kg), which enabled us to determine their LD<sub>50</sub> (V. B. Prozorovskiy, 1962). Therapeutic agents were given intramuscularly after 1-5 min: atropine (10 mg/kg), diethyxime (20 mg/kg) or dipyroxime (10 mg/kg). We assessed the antidote action of these agents according to the index of therapeutic efficacy: ratio of LD<sub>50</sub> with treatment and without treatment. We assayed cholinesterase activity in tissues of rats poisoned with pesticides (LD<sub>50</sub>) and treated with CR by the method of Hestrin (1949). The animals were sacrificed in the agonal period, and surviving ones 90 min after giving the pesticides and CR. We tested the capacity of diethyxime (20 mg/kg) to normalize myoneural transmission of stimuli with use of carbofuran (8 mg/kg) and elokron (55 mg/kg) according to capacity of the gastrocnemius to produce action potentials in response to

both isolated and rhythmic (30-100 Hz) stimulation of the rat's sciatic nerve with maximum electric stimuli, as well as according to changes in frequency, duration and amplitude of spontaneous miniature potentials of the end plate (MPEP) of the lateral muscle of the 8th-10th segment of the tail. MPEP was derived intracellularly using microelectrodes and the conventional method (P. G. Kostyuk, 1960). In this case, the rats were anesthetized with urethane (1 g/kg) and, if their condition worsened, they were switched to artificial respiration.

## Results and Discussion

In the therapeutic dosage of 20 mg/kg, diethyxime had a marked antidote effect in treatment of rats poisoned with all of the tested carbamate pesticides (Table 1). The index of therapeutic efficacy constituted 1.54-2.87. When animals were given elokron and kroneton, the therapeutic effect of this reactivator was on the same level as atropine. Concurrent administration of diethyxime and atropine (10 mg/kg each) led to summation of the therapeutic effect. In this case, the best results were obtained in treatment of rats poisoned with carbofuran (half the animals survived after being given almost 9 lethal doses of the pesticide), as well as pyrimor (index of therapeutic efficacy was 5.4). It is important that poisoning developed much later with diethyxime and atropine therapy than with use of the cholinolytic alone; seizures, fibrillation of muscles and exophthalmus were less marked. As can

Table 1.  
Indexes of therapeutic efficacy of atropine, the CR diethyxime and dipyroxime after giving white rats carbamate pesticides

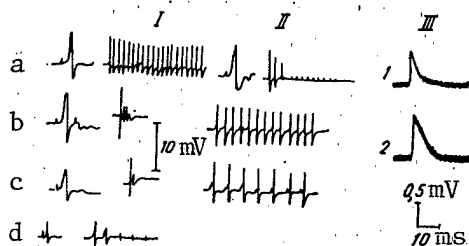
PESTICIDE AND ITS LD <sub>50</sub> MG/KG	ATROPINE (10 MG/KG)	DIETHYXIME (20 MG/KG)	ATROPINE + DIETHYXIME (10 MG/KG EACH)	DIPYROXIME (10 MG/KG)
CARBOFURAN (8)	6,0	2,87	8,75	1,2
ELOKRON (55)	1,8	1,69	2,84	1,1
PYRIMOR (155)	4,2	1,54	5,4	1,2
KRONETON (420)	2,2	1,78	4,0	1,0

be seen in Table 1, when the rats were treated with dipyroxime (TMB-4) there was no appreciable change in toxicity of any of the carbamate pesticides, while the clinical signs of poisoning were just the same as in untreated animals.

In order to verify the reactivating effect of diethyxime, we measured cholinesterase activity in blood and brain of rats given carbofuran and elokron. Already 30 min after giving carbofuran (8 mg/kg), cholinesterase activity was depressed by 81, 64 and 71.7% in serum, erythrocytes and brain, respectively, and after giving elokron (55 mg/kg), it was depressed by 77, 91 and 61%. Spontaneous restoration of activity of this enzyme was observed no sooner than after 24 h. According to the data of Ye. N. Burkatskaya et al. (1980), depression of cholinesterase activity also plays a leading part in the mechanism of toxic effect of pyrimor.

When the rats were treated with the CR, diethyxime (20 mg/kg), activity of this enzyme 90 min after giving them carbofuran and elokron was restored the most (by 61-70%) in the brain, then in blood serum and erythrocytes (30-36%). In this case, the CR, dipyroxime, was ineffective.

Diethyxime not only increased the survival rate, but eliminated the neuromuscular block that developed under the effect of carbofuran and elokron. Thus,



Action potentials of rat gastrocnemius in response to indirect stimulation after administration of carbofuran (I) and carbofuran together with the CR, diethyxime (II), and spontaneous miniature potentials of segmented lateral muscle of the rat tail before III, 1) and after (III, 2) giving carbofuran (8 mg/kg)

- I: a) single and rhythmic (100 Hz) nerve stimulation before giving carbofuran  
 b) 10 min after carbofuran (8 mg/kg)  
 c) single and rhythmic stimuli (50 Hz) 20 min after carbofuran  
 d) single and rhythmic (20 Hz) stimuli 40 min after giving carbofuran
- II) 60 min after carbofuran (8 mg/kg) and diethyxime (20 mg/kg)
- III: a) single and rhythmic (100 Hz) stimuli  
 b,c) rhythmic stimuli (50 and 20 Hz, respectively)

and elokron. The number of cases of appearance of MPEP increased by 42 and 92%, respectively, as compared to the base level. This indicated that there is alleviation of spontaneous release of quanta of acetylcholine by the presynaptic membrane under the effect of these pesticides. The substantial increase in amplitude (by 68-80%) and duration (by 84-87%) of MPEP (see Table 2 and Figure, III) were indicative of stabilization of the process of interaction of acetylcholine with the cholinoreceptor of the postsynaptic membrane as a result of depression of synaptic acetylcholinesterase. For this reason, it is quite apparent that the changes in MPEP amplitude and duration under the effect of carbofuran and elokron should be interpreted as a result of their anti-cholinesterase action. Such changes in polarization of the postsynaptic membrane occur under the effect of highly toxic organophosphorus pesticides (S. D. Kovtun and N. V. Kokshareva, 1980).

in control animals, maximum isolated and rhythmic (100 Hz) stimulation of the sciatic nerve was associated with an amplitude of  $10 \pm 0.92$  mV of muscle action potentials (see Figure, Ia). Administration of both carbofuran and elokron ( $LD_{50}$ ) was associated, within the first few min, with appearance of visible signs of poisoning followed by development of a neuromuscular block in transmission of stimulation. As can be seen in the Figure, Ib, already 10 min after giving carbofuran (8 mg/kg) muscle action potentials in response to isolated stimuli were followed by fading discharges and in the case of rhythmic stimulation (100 Hz), there were responses only to the first 3 stimuli with drastic decrease in the last two. Subsequently (see Figure 1c, d), conduction of high-amplitude impulses (50-20 Hz) was also blocked, while the amplitude of muscular action potentials in response to isolated stimuli decreased by 50%, as compared to the base value. Animal death occurred 40-60 min after giving the pesticide.

The data obtained with use of derivation from the end plate revealed (Table 2) that there was significant increase in frequency and amplitude of MPEP within the first 30 min under the influence of carbofuran

Table 2. Changes in parameters of miniature potentials of end plate of lateral segmental muscle of rat tail 30-40 min after administration of carbofuran, elokron and the cholinesterase reactivator, diethyxime (20 fibers)

PARAMETER	CONTROL	CARBO-FURAN (8 MG/KG)	P	CARBO-FURAN + DIETHYXIME (20 MG/KG)	CONTROL	ELOKRON (55 MG/KG)	P	ELOKRON + DIETHYXIME
FREQUENCY, IMP/S	1.33 ± 0.14	1.97 ± 0.21	ΔΔΔ < 0.02	1.25 ± 0.28	0.64 ± 0.08	1.23 ± 0.06	ΔΔΔ < 0.01	0.7 ± 0.14
AMPLITUDE, MV	0.44 ± 0.03	0.74 ± 0.07	ΔΔΔ < 0.05	0.36 ± 0.03	0.30 ± 0.02	0.54 ± 0.09	ΔΔΔ < 0.05	0.29 ± 0.02
DURATION, MS	2.59 ± 0.01	4.79 ± 0.18	ΔΔΔ < 0.001	3.10 ± 0.21	2.45 ± 0.12	4.6 ± 0.45	ΔΔΔ < 0.01	2.67 ± 0.27

When rats poisoned with carbofuran and elokron were treated with diethyxime (20 mg/kg), neuromuscular transmission did not change appreciably with stimulation frequency of up to 50 Hz for the duration of the experiment (90 min). However, at higher frequency (100 Hz), impulse conduction was not fully restored (see Figure, IIa). As can be seen in Table 2, already 30 min after the combined administration of pesticides and diethyxime, there was normalization of spontaneous activity of the myoneural synapse. Slowing of MPEP to the control level caused by administration of the CR is a result of normalization of release of quanta of mediator by the nerve ending. The decrease in amplitude and duration of MPEP confirmed the fact that diethyxime restored to a considerable extent the activity of synaptic cholinesterase soon after the pesticides were given.

These studies demonstrated for the first time the marked therapeutic activity of the CR, diethyxime, in laboratory animals poisoned with carbamate pesticides. The action of diethyxime differs from that of diproxime and other quaternary reactivators, which do not have an appreciable effect on toxicity of carbofuran, elokron, pyrimor and kroneton. According to the data of Z. A. Aleksashina (1969), TMB-4, 2-PAM and DAM virtually failed to restore cholinesterase activity in rats poisoned with sevin. Apparently, the therapeutic effect of diethyxime is attributable to its capacity to restore quite rapidly the activity of the inhibited enzyme, not only on the periphery, but in the central nervous system. At the same time, diethyxime has cholinolytic properties (N. V. Kokshareva and V. Ye. Krivenchuk, 1978), for which reason there is summation of the therapeutic effect, when it is given with atropine. All this warrants the inclusion of diethyxime, for which permission for use in clinical practice has already been granted, in combined therapy of poisoning by carbamate pesticides with anticholinesterase activity.

### Conclusions

1. When given once to white mice intragastrically, toxic doses of carbofuran and elokron have a marked anticholinesterase action and cause considerable changes in activity of this enzyme in the brain, erythrocytes, blood serum, as well as development of a block in myoneural transmission and functional impairment of presynaptic and postsynaptic structures in the synapse.



2. Diethyxime, a cholinesterase reactivator, elicits, unlike dipyroxime, a marked therapeutic effect on carbamate pesticide poisoning. Diethyxime therapy together with atropine leads to summation of the therapeutic effect and diminishes the toxicity, according to LD<sub>50</sub>, of carbofuran, pyrimor, kroneton, and elokron by 8.75, 5.4, 4.0 and 2.84 times, respectively.

3. The mechanism of therapeutic action of diethyxime in rats poisoned with carbamate pesticides is attributable to its capacity to restore cholinesterase activity in the brain, serum, erythrocytes, as well as to normalize myoneural transmission and spontaneous activity of myoneural synapses. It should also be borne in mind that diethyxime has a cholinolytic effect.

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10,657  
CSO: 1840/48

SPECIES MAKEUP OF ENTEROBACTERIACEAE VEGETATING IN SUPPURATIVE WOUNDS

Moscow LABORATORNOYE DELO in Russian No 11, Nov 82 (manuscript received 30 Nov 81) pp 677-679

VISHNEVSKAYA, S. M., Laboratory of Microbiology and Immunology, USSR Academy of Medical Sciences Institute of Surgery imeni A. V. Vishnevskiy

[Abstract] Studies were done on 230 samples of material containing enterobacteriaceae taken from patients with deep and extensive burns (143 cases) and suppurative wounds resulting from injuries, and also with wounds after dissection of suppurative sites (87 cases). In most cases (187) smears from the wound were also studied. Wound biopsy material was studied in 23 cases and urine in 20 cases. Material was subject to routine bacteriologic analysis, and the presence or absence of *Pseudomonas aeruginosa* was also determined. Primary identification of gram-negative bacteria was done using nine differential diagnostic tests. More detailed investigation of *Klebsiella* and *Proteae* was conducted using the Voges-Proskauer test, methyl red test, tests for amino acid decarboxylation (lysine and ornithine) and the presence of arginine dehydrolase, and the indole production test. The findings showed that, in almost 50% of cases, bacteria of the family Enterobacteriaceae vegetate in suppurative wounds in association with *Ps. aeruginosa*. The bacteria most frequently present were from the genus *Proteus*. Of these, *Proteus mirabilis* was predominant (61.6%), followed by *Proteus vulgaris* (19.2%), *Proteus morganii* (14.2%) and *Proteus rettgeri* (5.0%). References 12: 8 Russian, 4 Western.  
[120-9642]

METHODOLOGICAL BASES FOR ISOLATION OF NONSPORULATING ANAEROBES IN PYOSEPTICMIC DISEASES

Moscow LABORATORNOYE DELO in Russian No 11, Nov 82 (manuscript received 23 Jun 81) pp 680-683

KOCHEROVETS, V. I. and STOLBOVOY, A. V., Department of Microbiology and Clinical Surgery imeni P. A. Kupriyanov, Military Medical Academy imeni S. M. Kirov, Leningrad

[Abstract] Lack of precise methodological bases has hampered microbiologic diagnosis of nonsporulating anaerobic microorganisms in surgical infections. To correct this situation a system, divided into prelaboratory and laboratory stages, has been developed for isolating anaerobes in the above-mentioned conditions. All methods employed and tested are simple and available to clinicians and microbiologists. The prelaboratory methods include doing biopsies and taking smears from patients showing clinical signs of anaerobic infection. Thoracic anaerobic infections constitute the largest group in this category. All material for study should be obtained under strictest conditions of asepsis, and the nature of the pathology should be considered when this material is examined. The laboratory stage of the studies consists of the preparation of special mediums, salt solutions and equipment. A sequence for conducting microbiologic tests is described. Final identification is achieved by a study of the antigen and biochemical characteristics of the microorganisms isolated. References 12: 9 Russian, 3 Western. [120-9642]

PHAGE MS-2: STRUCTURE AND MECHANISM OF INFECTION OF CORYNEBACTERIUM  
GLUTAMICUM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, Dec 82  
(manuscript received 15 Jun 82) pp 971-974

VEPRINTSEVA, O. D., YEDINTSOV, I. M., IVANITSKIY, G. R., corresponding member, USSR Academy of Sciences, KUNISKIY, A. S. and OGANESYAN, G. G., Institute of Biological Physics, USSR Academy of Sciences, Pushchino, Moscow Oblast; Institute of Microbiology, Armenian SSR Academy of Sciences, Yerevan

[Abstract] The ultrastructure and effects of physicalchemical agents on phage MS-2 were investigated in order to derive information on possible mechanisms of infection of *Corynebacterium glutaminum*. The results showed that the head of the virion has the form of an icosahedron, with the icosahedral edge equal to  $335 \pm 25 \text{ \AA}$  and the distance between opposite hexahedron tips equal to  $640 \pm 25 \text{ \AA}$ . A  $2320 \pm 50 \text{ \AA}$  tail is attached to the head by means of a sleeve; it consists of 54-57 discs that are packed somewhat less densely than those in the T phages. On the basis of these considerations and the presence of the base plate, a mechanism of attachment to the bacterial surface is proposed, which involves structural changes in the proteins and ejection of the DNA into the bacterial cell. Such changes are believed to be readily reversible or minimal since they are not apparent on electron microscopy. Figures 2; references 8: 4 Russian, 4 Western.  
[126-12172]

## FUNCTIONAL ACTIVITY OF BACTERIOPHAGE T4 SHORT FIBRILS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, Dec 82  
(manuscript received 25 May 82) pp 974-977

ZINCHENKO, V. P., RUDIK, O. A., SELIVANOV, N. A. and MESYANZHINOV, V. V.,  
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Physics, USSR Academy of Sciences, Moscow; Moscow State University imeni  
M. V. Lomonosov

[Abstract] The effects of short fibrils derived from bacteriophage T4D on  
E. coli B/I were evaluated in terms of physiological parameters. The results  
showed that addition of 5-8 fibrils per cell rapidly enhanced respiration  
which was accompanied by  $K^+$  and  $H^+$  efflux from the cells. Higher fibril  
concentrations (20-30/cell) resulted in complete cessation of respiration that  
was irreversible. Low fibril concentrations also evoked a small increase in  
the pH of the bacterial surface, while higher concentrations had the opposite  
effect. Furthermore, bacterial membrane potential decreased reversibly in the  
presence of low concentration of the fibrils, while with high fibril concen-  
trations the decrease was irreversible. These observations indicate that  
the physiological changes seen in E. coli on interaction with T4 phages is  
due to the short fibrils, and that the rapid change in the ionic balance of  
the cell may be responsible for cessation of synthesis of bacterial macro-  
molecules in favor of synthesis of the early virus proteins. Figures 1,  
references 15: 2 Russian, 13 Western.

[126-12172]

POSSIBLE INVOLVEMENT OF THE VP<sub>g</sub> PROTEIN IN THE INITIATION OF ENCEPHALOMYOCARDITIS VIRUS RNA SYNTHESIS IN A CELL-FREE SYSTEM

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, Dec 82  
(manuscript received 18 May 82) pp 963-965

VARTAPETYAN, A. B., KUNIN, Ye. V., CHUMAKOV, K. M., BOGDANOV, A. A. and  
AGOL, V. I., Moscow State University imeni M. V. Lomonosov

[Abstract] Krebs II ascitic carcinoma cells were infected with encephalomyocarditis virus to study the possible participation of the VP<sub>g</sub> protein in the initiation of viral RNA synthesis. Using membrane-bound replicative complexes from infected cells (P 30 fraction obtained by centrifugation of the cytoplasm at 30,000g for 30 min), a control P 30 fraction from uninfected cells, and a solubilized P 30 fraction obtained by treatment with sodium deoxycholate it was shown that the membrane-bound replicative complexes form oligonucleotides with covalently bound low molecular weight proteins (identified as VP<sub>g</sub> following RNAase treatment and electrophoretic analysis). This observation implicates the VP<sub>g</sub> protein in the initiation of viral RNA synthesis by the replicative complex bound to cell membrane, since the protein is bound to oligonucleotides with less than 5-8 residues. Figures 2, references 11: 1 Russian, 10 Western. [126-12172]

## PHARMACOLOGY

### SOVIET SCIENTISTS SEEK BIOLOGICALLY-ACTIVE COMPOUNDS IN TROPICAL MARINE INVERTEBRATES

Moscow PRAVDA in Russian 4 Jan 83 p 4

[Article by PRAVDA correspondent N. Bratchikov: "From the Bottom of the Sea. Expedition Routes", Vladivostok]

[Text] The Scientific Research Vessel "Professor Bogorov" has set out on a regularly-scheduled voyage from its mooring at the Far Eastern Scientific Center, USSR Academy of Sciences. Below is the report of the Expedition's supervisor, Doctor of Chemical Sciences V. Rasskazov, prior to the expedition.

"This is the 15th voyage of the 'Professor Bogorov' in the world ocean. Why are we going there? Simply stated, for medicines. The Pacific Ocean Bio-organic Chemistry Institute, especially during the past decade, has conducted intensive investigations of marine organisms as sources of physiologically-active compounds. Corals, algae, sea urchins and starfish, sea cucumbers, sea anemones and tunicates, several fish species--all these are 'objects' from which one can isolate preparations capable of curing many diseases."

A marine pharmacy... Man began to recognize it comparatively recently. But the ocean does not care to disclose its secrets so quickly. Scientists involved in the study of marine organisms, in particular invertebrates, have determined that extremely active signal substances play an especially important role in the life of these creatures. Some of them possess an attracting action. With their help, males and females find one another in the ocean. Others permit invertebrate larvae to find suitable habitats. Still others warn of danger. By utilizing the signals, man can learn to regulate submarine life in artificial marine plantations.

It has been demonstrated that marine invertebrates contain very active substances capable of countering resistant bacteria.

Here there began a veritable march of bioorganic chemists from many nations into the oceanic spaces, to coral reefs. Far Eastern scientists have also gone to them. Why here specifically? Under the burning rays of the southern sun, in warm lagoons, is an unusual array of marine organisms. Special

conditions have evidently permitted the local flora and fauna to acquire special qualities in the course of millions of years. A floating laboratory, in which preliminary experiments can be immediately performed, made it possible for Far Eastern specialists to enter the first ranks of marine researchers, to obtain the most interesting results in the field of knowledge of the physiologically-active compounds of marine organisms. The scientists of the Bioorganic Chemistry Institute have more than once had occasion to participate in expeditions within the framework of the international program of VVESTPAC.

One of the most recent voyages of the "Professor Bogorov" is recalled. At that time the Far Easterners went to the coasts of Vietnam, where they gathered an interesting collection of medical preparations from marine invertebrates, which were there in abundance.

Then the scientists told me how difficult it is to reach the "marine pharmacy". Work in the tropics, and especially under water, requires maximum self-discipline, great attentiveness and resourcefulness. The depths to which they descended in diving suits swarm with predators--morays, sharks, skates, fish with poisonous spines.

"If we total up," recalls Candidate of Chemical Sciences A. Pavlenko, "we find that the scientists and divers spent 29 days on the sea bottom. Fifteen to twenty people were continuously involved in the search for biologically-active material. The remainder were occupied with analyzing the findings, readying preparations and determining their physiological activity."

During the voyage, the expedition obtained valuable information on the species composition of the marine invertebrates of this zone. Numerous samples of mollusks were prepared for chemical and biological studies under laboratory conditions.

The time will come when the production of drugs obtained in the ocean will be placed on a commercial basis. Does this mean that it will always be necessary to go to the depths of the ocean for the procurement of exotic raw material? Not at all. Marine organisms at the present stage of study are only the material for generating original ideas and technologies. Further investigations will guide the thought of the bioorganic chemist along the correct path for obtaining valuable substances from simple chemical compounds.

The present expedition will continue the investigations of the ocean. It will go to the reefs of Sri Lanka, the Maldivé Republic, Seychelles Islands, Madagascar...

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CSO: 1840/138



SMALL ANGLE X-RAY DIFFRACTION IN STUDIES ON INTERACTION OF LIPOSOMES WITH  
CYTOPLASMIC BRAIN PROTEINS

Moscow DOKLADY AKADEMII NAUK SSSR in Russian Vol 267, No 4, Dec 82  
(manuscript received 15 Jun 82) pp 980-983

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[Abstract] Small angle X-ray diffraction studies were conducted on the inter-  
action of polydisperse liposomes, prepared from cattle brain lipids, with  
soluble cytoplasmic proteins derived from cattle cerebral cortex. The results  
demonstrated that interaction of the proteins with the liposomes was accompanied  
by changes in the electronic density profiles of the liposome walls, indicating  
that at least some proteins penetrated the lipid bilayer and that other protein  
molecules became adsorbed to the external surface. Figures 3, references 12:  
6 Russian, 6 Western.

[126-12172]

## PUBLIC HEALTH

### INADEQUATE SUPPORT FOR CHILDREN'S HOSPITAL IN LENINGRAD

Moscow VODNYY TRANSPORT in Russian 4 Nov 83 p 3

[Article by Ye. Viktorova: "Adult Problems of a Children's Hospital", Leningrad]

[Text] "'Rest for us is only a dream'--this refers to us it seems," smiles Klara Yakovlevna Zasukhina. She heads the pediatric service of the Baltic Central Basin Hospital imeni G. I. Chudnovskiy.

The children whose parents work on the waterways of the northwest are sent to Leningrad, to Vasil'yevskiy Island, to the small--numbering a total of 100 beds--children's department of the hospital. Its staff personnel provide medical and organizational-procedural assistance to pediatric institutions in remote corners of the Leningrad and Vologoda oblasts and of Kaliningrad. More than 18,000 children are under the observation of the department's specialists.

It is a rare day here that passes without an alarmed telephone call from Vytegra, from Sviritsa, from Sheksna. And now already a physician is setting out: he must catch an airplane, then board a cutter. But this is business as usual for the physicians.

And here, on Vasil'yevskiy, the surgeons have gathered for a conference: a medical attendant from far away is describing in detail by telephone the illness of a child who is just being brought to Leningrad. Now the physicians can discuss the details of the impending operation.

The children's department of the Hospital imeni G. I. Chudnovskiy is further unusual in that a vast network of therapeutic-prophylactic and sanitary institutions has been created on its basis--three polyclinics serving 9,000 young Leningraders and the pediatric service of Kaliningrad Port Hospital, protecting the health of 2,500 children. A polyclinic department has also been created in Petrokrepost'. Furthermore, under the jurisdiction of the United Water-Transport Workers Children's Hospital, day nurseries, kindergartens and schools in Leningrad and the oblast--everywhere where sailors and river-transport workers labor. For their children, two 155-bed sanatoria have been constructed, in which about 1,000 children are treated annually.

In the summer the physicians are frequent guests at pioneer camps and at dachas.

The continuous care and careful attention for the well-being of each child bears fine fruit: the little ones take ill less frequently. Whereas in Leningrad as a whole during the past year the volume of medical certificates issued to parents for the care of ill children comprised 1,105 per 1,000 children, of 1,000 young patients of the Hospital imeni G. I. Chudnovskiy only 733 took ill. And the volume of certificates for the care of ill children was correspondingly less than half of the average for the city.

"The concern and effort associated with children's health care--this is our main business. Here you never expect rest, what is to be done--children are the most susceptible to all drafts and viruses," says K. Zasukhina, continuing the conversation. "Another thing troubles and angers us: we work under very difficult conditions, often not finding support from those who, it would seem, should be the first to help us. Here, for example, in Sviritsa we have a nursery. Its chief, A. Sazonenkova, was able to organize the activity of her group such that she achieved the lowest morbidity among all basin nurseries and the highest attendance in the course of several years."

"And next to this nursery, literally several meters away, is located a children's garden. According to the staff list it has no medical worker, and this has a marked impact on the health of the children. Recently in the kindergarten there were outbreaks of measles and chickenpox. We proposed that the nursery and garden be united into a single children's center. The children's medical care would have been improved; the need for junior service personnel would have been reduced. But, alas. Here is the response to our proposal," Klara Yakovleva shows a letter printed on a form of Northwestern River Shipping. It said:

"In connection with your proposal for the reorganization of the service of the preschool children's institutions in the village of Sviritsa, Leningrad Oblast, I report that at the present time the indicated institutions are heated by three small boiler houses, which in connection with the high water level are subject to flooding. Furthermore, each boiler house has its own service personnel. Unification would require a common boiler house, which at the present time cannot be done by reason of the absence of the appropriate equipment and finances. Deputy Director, Northwestern River Shipping, V. Malyshev."

Undoubtedly, the creation of a single heating system for the center is a troublesome and complicated matter. But is it not really more important that the mothers and fathers of the children, having brought them to the children's garden, can attend to their work calmly, knowing that their children are with experienced and good people in white gowns.

There are, unfortunately, not a few problems of a similar nature in the pediatric service of the Baltic Central Basin Hospital imeni G. I. Chudnovskiy.

Here is one further example. The children's department of the River-Workers Hospital in Sheksna was closed by order of the sanitary-epidemic station. Months have passed since then, and there is no hope that the department will

open soon. This region is difficult, it is hard to get to Leningrad from there and the children's department is much needed. And it is hard to believe that the sponsors--the shipping enterprises located in this region--do not have the power to set the building in order and to repair the heating system.

Still another question remains open, urgently confronting the children's department of the Baltic Central Basin Hospital imeni G. I. Chudnovskiy. The problem is that the hospital physician staff was recently reduced. Many of the most experienced pediatricians were released; the primary service of child patients lost its vigor. At the same time the character and volume of the work for the physicians and the number of children in the districts are by no means different from the typical city territorial districts. This problem also demands the most fixed attention of the Leningrad Basin Komflot [Communal (?) Fleet].

The sanitizing process does not always run smoothly during the summer months. The problem is that most dacha buildings are structures of the summer type, and summer in the northwest, as is known, is frequently cool and rainy. This means that it is necessary either to construct modern permanent dachas for the children's institutions or else seriously begin repairing and heating the existing dachas.

The pediatric service of the Baltic Central Basin Hospital imeni G. I. Chudnovskiy is protecting the health of the children and thus that of our future. And each of us, of course, wants the new generation to grow strong and healthy. But all of us together must now begin thinking about this.

9942

CSO: 1840/131

## NEW VILLAGE HOSPITAL IN TADZHIK SSR

Dushanbe KOMMUNIST TADZHIKISTANA in Russian 1 Dec 82 p 3

[Article by E. Kozlova, correspondent for KOMMUNIST TADZHIKISTANA, Matchinskiy Rayon, in the column "Reportage": "A Health Complex in the Virgin Lands"]

[Text] A city dweller, I had never had occasion to speak on a videotelephone. I confess that I had never even seen one. And I never expected that an introduction to the videotelephone would occur in a remote village in the virgin lands, at a recently constructed uchastok hospital.

"Look here," said the technician. A bell sounded, and on a small screen there appeared the image of one of the members of the state commission that is receiving the hospital from the builders.

The videotelephone will permit people arriving to visit patients to speak with a patient, to see him and to converse with the attendant physician without climbing, say, to the fourth floor.

"Village health care is now moving towards providing the population specialized care," says the rayon head physician, Radzhab Niyazov. "This is why the new hospital has children's, maternity, therapeutic and neurological and infectious departments. Furthermore, for the first time in village uchastok hospital practice in the oblast, a department has been established here for rehabilitative treatment--the physical clinic. It has the latest equipment, as does the entire hospital. The Kochoz imeni Kalinin spent 200,000 rubles for hospital medical equipment. And the construction of the treatment complex as a whole ran 1,800,000 rubles. Its construction was paid for by three kolchozes--imeni Zhdanov, Komsomol and imeni Kalinin.

The new 135-bed village uchastok hospital is the largest in the oblast and the fourth built in Matchinskiy Rayon. The health complex occupies about nine hectares. The beautiful, modern building has undoubtedly also become an architectural monument in Sardob village and in the entire Dal'verzhinskaya Steppe.

The hospital was constructed by the best teams from the Mobile Mechanized Column-17 of the Leninabad trust "Sel'stroy-4"--Aziz Niyazov's and Gul Safarov's brigades and Asa Dzhabarova's finishers. They have worked for seven years according to the Zlobin method and have won more than one republic and oblast competition for quality.

Many innovations were introduced at the site. For example, terrazit [colored building stucco] was used in the facing of a building for the first time in construction at the village. Within the building, the stairs were finished in local marble and travertine slabs. The floor covers of the best linoleum are practical and convenient; it is pleasant to gaze at the walls, finished with softly colored materials.

It cannot go without mention that for the first time in a village hospital a powerful air-conditioning system was installed, which will provide the halls with moist cool air in the summer and warm air in the winter. Three floors are linked by passenger and service elevators.

The hospital was built with outstanding quality from start to finish. It was constructed such that patients could be accommodated the day after completion; the physicians do not have a single complaint against the builders, which in itself is remarkable.

The villagers will also have no few grateful words for the builders because they were able to preserve a large garden around the health complex. Two fountains were built in the health-complex yard, paths were marked out and rest corners were created. Flower, conifer and shrub beds have transformed the site of the complex into a green zone of rest and health.

Construction is being completed next to the hospital on three 12-unit apartment houses for the medical workers.

In the plan of social development outlined by the 26th Party Congress and in the resolutions of the CPSU Central Committee May Plenum, which ratified the Food Program, special attention was given to improvement of the life and daily affairs of village workers, the protection of their health. The new hospital in the virgin lands is further testimony of the tireless concern of the Party and government for the welfare of the people.

Next year in Buston construction will begin on a modern polyclinic of 600 places; a large central pharmacy is already under construction. Much is also being done at rural populated points. Thus, at the Kolchoz imeni Kalinin an out-patient clinic has been constructed for 200 visits, and an out-patient, polyclinic service is under development. The rayon medical cadres are adequate--about 100 physicians are prepared to render the residents of Matchinskiy Rayon any assistance. A branch of the Leninabad Medical School is active in the rayon, which graduates 30 nurses annually.

All rayon medical points, out-patient clinics and polyclinic have changed to a new operating schedule--no closed days, and receiving continues to 8 pm, which is very convenient for rural workers.

9942

CSO: 1840/116

SOVIET SCIENTIST DISCOVERS NEW METHOD FOR TREATING MYOCARDIAL INFARCTION

Moscow SOVETSKAYA ROSSIYA in Russian 5 Dec 82 p 6

[Article by Vsevolod Mar'yan, Moscow: "Infarction Retreats: Professor Aleksandr Krayev and His Colleagues Move Towards Conquest of a 'Disease of the Age'"; passages rendered in all capital letters printed in boldface in text]

[Text] On the basis of authority vested by the government of the USSR, the USSR State Committee for Inventions and Discoveries has issued the present author's certificate for the invention "Method for Treating Acute Myocardial Infarction".

(Excerpt from Author's Certificate No. 825079).

The resuscitation vehicle rushed down Marshal Rybalko Street and stopped at house No. 22. At 8:10 am Zoya Vasil'yeva B., a 73 year-old pensioner, was delivered to the Intensive Care Department of the 52nd Moscow City Clinical Hospital with a preliminary diagnosis of acute myocardial infarction. Department chief A. B. Besprozvanny and attendant physician Ye. M. Zeltyn' quickly set about examining the patient. A dictophone tape records the data for patient No. 17112: sharp persistent pain in the left half of the chest, tachycardia... After taking the blood pressure and electrocardiogram, the physicians established the final diagnosis to be myocardial infarction... There then follows the complex term for the most severe lesion of the cardiac muscles, occurring against a background of an entire group of attendant diseases, each of which by itself is capable of leading to a grievous outcome.

With the usual method for treating myocardial infarction the best outcome for a patient in such a situation would be the formation of a myocardial scar. What will the physician do? Up to a certain point they will follow the generally accepted method. But---stop! Now physician Ye. M. Zeltyn' and nurses K. D. Vishnyakova and A. F. Dorokhina commence some new manipulation, as yet unknown to me. With a special apparatus the patient is newly administered intravenously a polarizing mixture and a mannitol preparation....

PROFESSOR AND DOCTOR OF MEDICAL SCIENCES A. V. KRAYEV'S EXPLANATION:

"During myocardial infarction the blood supply to the cardiac muscle is disrupted, and oxygen delivery to it is reduced sharply. This leads to the appearance of dead cells and various toxic substances in the infarction zone, which are removed from the lesion area primarily by the lymphatic vessels. Because of the incapacity of the diseased organism for the adequate independent activity of this process, connective tissue--in everyday terms a scar--also later develops.

"All preparations earlier used in world cardiology for myocardial infarction have not had purposeful effect on this vitally important process."

After extended research Professor A. V. Krayev established the general pattern: during acute inflammations there develops a congestion of various undesirable substances, which also disrupt the normal functional characteristics of individual organs and of the entire organism as a whole.

A similar pattern is characteristic of many severe diseases, including myocardial infarction. Having made this conclusion, the scientist posed the problem of studying the behavior of organs and tissues under conditions where the lymphatic vessels are freed and the toxic products, from proteins and from the cells killed as a result of inflammation, are removed from the diseased organ. By what means? By means of dilating the lymphatic vessels. In the course of the research drugs were selected possessing such properties.

This scientific idea was tested by Aleksandr Vasil'yevich Krayev on a large group of experimental animals. The results of the experiments provided the basis for approbation in clinical practice of the data obtained by the scientist. Actively participating in this work were professors Yu. M. Levin and V. N. Orlov, Candidate of Medical Sciences M. S. Berdichevskiy and the physicians A. Ye. Sorokatyy, A. E. Radzevich, D. Ye. Yerzhanov, N. A. Shilova, N. I. Gaydukova and I. A. Libov.

It was precisely here, at the Intensive Care Department of the 52nd Moscow Clinical Hospital, that the new idea's application for treating acute myocardial infarction was developed and introduced. Its results have been confirmed by an author's certificate of the USSR State Committee for Inventions and Discoveries.

...Let us return to the clinic. Exactly three hours have passed since the start of the treatment. Only three hours. With the usual method, treatment sometimes lasts for months. And look! A repeat electrocardiogram reflects an improvement in all parameters of cardiac activity. In three days, manifold limitation of the peri-infarction zone has been documented in the patient. That is to say, the scar which will remain on the wall of the heart will be approximately 10 times smaller than with the traditional means of treatment. This, during extensive infarction. And with microinfarctions, a repeat electrocardiogram shows complete absence of scars. In three days the patients are released from Professor V. N. Orlov's clinic as absolutely healthy. Here a one hundred percent cure after microinfarctions has already been achieved.



And so, the basis exists for speaking of a conspicuous discovery by a Soviet scientist, Professor A. V. Krayev and his subordinates. The simplicity and accessibility of the new treatment method, which is completely safe for the human body, permits the hope that it will receive wide dissemination in the near future. But it must first be incorporated into emergency medical care. This will save thousands of people of widely differing ages in critical situations.

It is thought that the USSR Ministry of Health and the Moscow City Soviet Health Department will take the necessary measures for creating favorable conditions for Professor A. V. Krayev's further successful work. Clearly, the actualization of the foregoing and a number of other of the scientist's no less valuable and topical ideas may have a specific impact on the successful conquest of severe diseases.

9942

CSO: 1840/121

## NUTRITION INSTITUTE GUIDELINES

Moscow IZVESTIYA in Russian 30 Nov 82 p 1

[Untitled article]

[Text] The USSR Academy of Sciences concerning the satirical article "Nothing Under the Sauce." Measures were adopted for improving the scientific activity of Nutrition Institute members; a careful screening of patients liable to hospitalization at the clinic was instituted.

The USSR Academy of Medical Sciences Presidium has discussed the satirical article "Nothing Under the Sauce", published in the newspaper IZVESTIYA (No. 250/251). The critical comments directed at the USSR Academy of Medical Sciences Nutrition Institute were recognized as correct. The critical comments were received in a business-like manner by members of the USSR Academy of Medical Sciences Nutrition Institute. The Institute's management has taken measures to correct the situations that had developed. A number of the deficiencies revealed have already been eliminated. Thus, the procedure for patient hospitalization at the therapeutic nutrition clinic has been changed: patients are screened strictly in accordance with scientific criteria; representatives of the Peoples' Control Group of and the Party Commission for Control of Administrative Activity have been included in the screening commission; an obligatory preliminary consultative examination of patients sent to the clinic has been introduced.

A permanent worker's group was created to improve the coordination and planning of scientific research at the Institute.

The USSR Academy of Medical Sciences Presidium has obliged the director of the Nutrition Institute, V. A. Shaternikov, to vouch for the fulfillment of the planned measures for eliminating deficiencies. The fulfillment of these measures is being monitored by the Presidium. In order to strengthen control of the activity of scientific research institutions in the USSR Academy of Medical Sciences system, the USSR Academy of Medical Sciences Presidium decided to consider in 1983 a number of questions aimed at enhancing the effectiveness of scientific research and the strict observance of economic and financial discipline.

OUR EXPERIENCE IN CONDUCTING THOROUGH PREVENTIVE EXAMINATIONS OF THE RAYON'S RURAL POPULATION

Minsk ZDRAVOOKHRANENIYE BELORUSSII in Russian No 11, Nov 82 (manuscript received 6 Apr 82) pp 48-50

[Article by V. A. Rozhko, Ostrovets Central Rayon Hospital, Grodno Oblast]

[Text] The health of our people is our country's principal wealth. Effective dispensary treatment of the population has enormous significance to solving the problems of preserving and reproducing labor resources and combatting labor losses associated with illness and disability. The most important element of such treatment is mass integrated medical examination. The juvenile population of Ostrovetskiy Rayon has been undergoing blanket dispensary treatment for the last 10 years. This has produced good results: Child morbidity decreased to less than a third of its previous level. Absences among school-children due to illness decreased to less than a fifth of the 1976 level. All children are subjected to planned and prompt health improvement, mainly during school vacations.

Special attention is also devoted in the rayon to reducing morbidity involving temporary incapacitation and first-time disability in the adult population. To insure correct solution of these problems, seminars on certification of temporary incapacitation are being organized for physicians. In them, all physicians study a particular topic and take a test on it. Physicians participate continuously in the work of a traveling temporary incapacitation certification commission, and they submit reports on the progress being made by patients brought up to the commission. As a rule, moreover, once every 4 years each physician in the rayon undergoes advanced training in his specialty at institutes for the advanced training for physicians. Outpatients are received at the rayon polyclinic in 20 basic specialties: traumatology, urology, surgery, oncology, gastroenterology, hepatology, rheumatology, cardiology etc. Narrow specialization affords a possibility for better and broader examination, treatment and provision of dispensary services to patients. However, if we are to reduce morbidity involving temporary incapacitation and first-time disability, we must not only reveal patients in the early stages of disease and cure them promptly, but we must also reveal people predisposed to a given disease and take all steps to prevent development of morbidity among persons in the risk group.

Eight years of experimental work aimed at dramatically reducing tuberculosis led to a decrease in this disease by a factor of 8.7. In my opinion to reduce morbidity involving temporary incapacitation, the population must be subjected to blanket dispensary treatment, which is what we began in 1981.

In the first phase the entire population is subjected to thorough examination by the polyclinic of the rayon hospital, by the outpatient clinics of rural section hospitals and by a traveling brigade composed of a physician, an X-ray technician, three or four middle-grade medical workers and an obstetrician. Their responsibilities include conducting a medical examination, measuring arterial pressure, determining visual and hearing acuity, measuring intraocular pressure and registration of the EKGs of persons over 35 years old, conducting fluorography, providing obstetric examinations to women and subsequently analyzing the cervical contents of women over 30 years old, examining and cleansing of the oral cavity by a stomatologist, and analyzing the hereditary and medical history. A preventive medical record we developed is filled out for all examinees. On it, the disease diagnosis is indicated and all analyses performed in different years are noted. We also fill out a medical control card (see below), which is kept at the therapeutic institution nearest to the examinee's home. Maintenance of the medical records significantly increased the participation of the population in occupational examinations, and it afforded a possibility for referring residents of the rayon to a physician at the rayon polyclinic; if the medical record shows the occupational examination had been performed, it is not repeated. This significantly facilitates the work of registrars, and it has reduced the time required to examine patients in the polyclinic. Continuity of treatment in different therapeutic institutions of the rayon has improved. A patient who comes to the polyclinic is immediately received by the needed specialist. In 1981 92 percent of the rayon's whole population underwent the first phase of blanket dispensary treatment, as a result of which 386 persons out of every 1,000 residents were placed under dispensary observation. Filling out the medical control cards is especially important at feldsher-midwife points. A paramedic keeps the health of a resident within his section under observation and notes down all occurring changes on the card. If necessary he refers the patient to the appropriate specialist, who then sends his conclusion to the therapeutic institution at the patient's home. The feldsher or a physician of a rural medical outpatient clinic then acts on the recommendations suggested in the conclusion made by the rayon hospital physician. Thus a patient's attendance is monitored by section physicians, by physicians of rural medical sections and by the directors of feldsher-midwife points.

Following a thorough medical examination persons found to be ill are put on record, and persons with a propensity for disease (persons in the risk group) are kept under constant surveillance with the purpose of preventing aggravation of disease in the patient and development of disease in persons in the risk group. Both dispensary patients and persons in the risk group are kept under surveillance by section physicians and by specialists at the rayon polyclinic. This system of preventive measures is making it possible to improve the health of the rayon's population purposefully and systematically, to reduce morbidity involving temporary incapacitation and to prevent disability.

MEDICAL CONTROL CARD

Last name, first name, patronymic \_\_\_\_\_  
 Year of birth \_\_\_\_\_ Place of employment and position \_\_\_\_\_  
 Home address \_\_\_\_\_

Examination Date	Heredity	Oncological Diseases	Goiter	Skin Diseases	Pediculosis	Tape-worms	Arterial Pressure

Chronic Pneumonia	Cardio-vascular Diseases	Sugar Diabetes	Nervous Diseases	Gastric Pathology	Tuberculosis	Mental Diseases

Chronic Alcoholism	Kidney Diseases	Liver Diseases	Other Diseases	Where referred to, and when	Results of examination by feldsher	Results of examination by midwife

Signature of Medical Worker

## Conclusions

1. Preventive medical records should be initiated on every resident at the therapeutic institution nearest to his home and a medical control card should be maintained at feldsher-midwife points so as to permit organization of planned improvement of the health of patients and insure good continuity in treatment by different therapeutic institutions.
2. Blanket dispensary treatment of the population and planned, prompt improvement of the health of patients and of persons in the risk group are significantly reducing morbidity and first-time disability.

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CSO: 1840/113

## PSYCHOLOGICAL ASPECTS OF PATIENT REHABILITATION

Leningrad LENINGRADSKAYA PRAVDA in Russian 23 Nov 82 p 3

[Article by M. Kabanov, director of Leningrad Neuropsychological Scientific Research Institute imeni V. M. Bekhterev, professor and RSFSR Honored Scientist, in the column "Problems and Horizons in Science": "Towards a Full Life"; passages rendered in all capital letters printed in boldface in source]

[Text] In the modern world with the ever increasing velocities, nervous stress and high demands that scientific-technical progress presents mankind, one of the most important questions is that of mental health. This is why in our nation considerable attention is given to the creation of medicopsychological and psychotherapeutic services. Their task includes not only the prevention and treatment of many diseases but also the return of patients to an active life, their rehabilitation. This is the topic of the all-union conference opening today in Leningrad.

For many years the major interest of medical scientists and physicians was primarily the human body, the changes in its structure and functions caused by disease. The person himself with his thoughts and feelings was seemingly forgotten. He was considered, in the very expressive words of the World Health Organization vice-president, T. Lambo, "only as the chance battlefield on which the bacteriological conflict unfolds..."

Meanwhile it is well known that many diseases originate in mental traumas, the undeveloped interrelationships between people. This is why a reorientation of the thinking of the modern physician is so important today. His attention should be focused not only on bodily functions but also on the psychological characteristics of the patient. Modern medicine should be more aware of the medicopsychological and medicosociological aspects of diseases, while science should provide a comprehensive, systems approach to the study of human illnesses.

The Leningrad Scientific Research Neuropsychological Institute imeni V. M. Bekhterev--the nation's leading institution in medical psychology, whose 75th anniversary is today--has long attached great significance to mental factors in the development of various illnesses.

At the present time it has become evident that mental factors play no small role in ischemic heart disease, hypertension and peptic ulcers, diabetes and a number of other diseases that are generally termed psychosomatic (papers on this theme by Ye. I. Chazov, Z. I. Yanushkevichus, Ye. I. Sokolov and Yu. M. Gubachev--prominent Soviet scientists and internists who are quite wellknown in broad medical circles). It is now well understood that it is important not only to identify the damaged organ or part of an organ but also to visualize the type of person and life situation in which one or another disease state has arisen.

It is especially important to consider mental factors during patient rehabilitation. The concept of rehabilitation has been successfully developed over the last 15 years at our institute and encompasses a broad range of problems. By rehabilitation is understood an integral system of medical, psychological and social actions and measures directed not only at the greatest possible involvement of the patient (or invalid) in life and socially useful labor but also at the prevention of illness or disability. Scientific research on this problem is carried out by the combined efforts of physicians, psychologists and representatives of other specialties. It is conducted in close contact with practical institutions of health care units, a number of other scientific centers of the country and, also, with certain scientific and practical institutions in East Germany and Poland.

Briefly stated, the task of scientists and physicians specializing in rehabilitation is "not so much the addition of years to a man's life as the addition of life to years." The human life-span is getting longer. The number of elderly people is growing in our nation and in other developed nations. The successes of medicine, primarily in the field of drug therapy and surgery, have resulted in an increase in the number of people saved from death but having certain residual symptoms as consequences of the survived diseases, which are very frequently accompanied by dangers of all sorts, anxiety and fears for one's health.

Both elderly people, especially those lacking any kind of useful activity, and non-elderly people with residual disease symptoms (for example, survivors of myocardial infarction or surgery to remove a malignant tumor) are frequently troubled by a multitude of psychological and social problems: at work, in family life and in relations with neighbors. And to inspire in a patient faith in his strength, to help him change his frequently incorrect attitude to the disease and to promote a normalization of family interrelationships all require considerable art.

Let us say that a person cured of alcoholism after leaving the walls of the therapeutic institution often runs into a type of "impressment" at work. Former drinking partners irresistibly draw him into new drinking bouts, which, naturally, again lead to a relapse of the disease. And physicians ponder the question of how to make the life of a man suffering from one or another illness fuller and richer, how to teach him methods for a "psychological defense" from disease. This has become a most important task in both medical and professional and social rehabilitation.



Another aspect of the problem is the prevention of one or another complication in the course of a disease. And, finally, the truly most complex task is the prophylaxis of a disease at its sources (there now exists the "pre-disease" concept). Sometimes completely healthy people experience severe emotional stress in an extreme situation, which can lead to the development of neurotic states or psychosomatic disorders. The prevention of such symptoms is also an important goal in rehabilitation in its modern understanding.

Every year, for example, about three thousand patients are being treated in the clinics of our institute. After completing a course of therapy, the great majority return to health and an active life. Furthermore, our physicians and scientists are working on agreements at such well-known city enterprises as the Kirov Plant union, the Neva Machine-Construction Plant imeni V. I. Lenin, the Leningrad Metal Plant and others and are developing and introducing methods for group and family psychotherapy.

Rehabilitation measures are primarily directed at the patient's personality and stimulate its activity. They assist our patients to develop in conjunction with the physician and psychologist (and other specialists) the habits and life attitudes necessary for their recovery.

As we see, rehabilitation is a broad concept, including both therapy and education, and much more. Such an understanding is now gaining every increasing recognition both in our nation and abroad. The most favorable conditions for the development of ideas for the social and labor rehabilitation of patients and invalids are created in a socialist society with its state system of health care and social security and with its striving from early years to nurture in man an active life attitude and feeling of collectivism.

This is clearly exemplified by the scientific and practical activity of the Institute imeni V. M. Bekhterev, which several years ago was awarded a Diploma of the First Degree, while a large number of staff personnel were awarded Exhibition of Achievements in the USSR National Economy medals for scientific research and its practical application in the field of the rehabilitation of patients with nervous and mental diseases. It is not surprising that it was within the facilities of the Institute that the All-Union scientific conference was organized on the theme "Restorative Therapy and Rehabilitation of Patients With Nervous and Mental Diseases", which will summarize the results of long-term research in this field and outline tasks for its further development in the various republics of our nation.

Prominent scientists from a number of foreign countries, primarily socialist, are participating in the conference. The actual fact of the conference is a fine testimonial to the truth of the ideas of our institute's founder, Vladimir Mikhaylovich Bekhterev--ideas for an integral and comprehensive approach to the patient.

9942

CSO: 1840/101

SOCIOMEDICAL CHARACTERIZATION OF EMPLOYMENT OF PEOPLE OF RETIREMENT AGE

Moscow SOVETSKOYE ZDRAVOOKHRANENIYE in Russian No 11, Nov 82 (manuscript received 14 May 82) pp 26-29

[Article by S. P. Shilova, Perm Medical Institute]

[Text] The decline of birthrate, change in mortality indicators, marked migration processes and climatogeographic distinctions alter appreciably the age structure of the inhabitants of western Urals. Thus, in the last 20 years, there has been an increase in number of retired persons in Perm Oblast. And the rate of aging of the population was higher in the preceding period between censuses.

Evolution of demographic processes leads to an intensive labor balance, for which reason the social implications of employment of retirees, their role in development of the national economy increase. In the opinion of specialists, the postretirement period, which has grown longer, should not be viewed as beneficial to increased passive rest, but as the basis for prolonging the period of man's gainful employment (M. Ya. Sonin; A. G. Novitskiy and others). Gerontologists believe that inclusion of aging man in different forms of activities is one of the most important conditions for "beneficial aging" (I. V. Davydovskiy, V. V. Frol'kis and others). The foregoing reasons determine the urgency of the matter in question.

The purpose and objectives of our investigation were to determine the rate of employment among individuals who retired because of their age in different sectors of the national economy and to demonstrate the role of medical and social factors in formation of this parameter.

In order to obtain the necessary information, we used the results of interrogating 3000 individuals of retirement age on a program that we specially developed, as well as data from a study of health status of 8632 pensioners, according to visits to medical and preventive institutions, emergency medical care and physicals.

Analysis of employment of this group of pensioners revealed that the share that worked constituted 8.7% (10.2% for men and 8.2% for women) as the average for 1979. In urban areas, the employment rate of pensioners was considerably higher (10.2% versus 4.1%). In Perm, this parameter constituted 23.2% in 1972, 15.5% in 1980 and 26.1% in 1981.

Age and sex indicators of employment referable to the postretirement age were different. The highest share of employed people was noted for the first five years of retirement age (19.6% for men and 23.4% for women). As age advanced, the indicators dropped appreciably (from 16.3% for individuals 55-59 years of age to 1.4% for those 70 or older). It should be noted that the employment level for women at 60 years of age or older was considerably lower than for men of the same age. Thus, the answer to the question of continuing or stopping work is determined primarily by age and sex.

Most of the employed pensioners work in enterprises and institutions (96.3%). There is prevalence among them of individuals engaged in physical labor, which is consistent with the distribution of the entire employed population according to nature of labor. It should be noted that the rate of employment of women 60 or more years of age in the area of physical labor is 1.5 times higher than for men.

The intensity of employment of individuals of retirement age differs as a function of level of education: there are 18.1 workers per 100 individuals 60 or more years of age with higher education, 13.0 with secondary and incomplete secondary education and 6.5 with elementary education, i.e., there is a more marked decline in number of employed pensioners with less education.

Analysis of indicators of employment of individuals of retirement age in different sectors revealed that most of them continue to work in their former jobs. This applies in essence to engineering and technical personnel, educators and physicians. This group of workers merits special attention on the part of management, medical workers and hygienists, since by continuing to work actively they have an appreciable influence on the employment situation of elderly people. The return to work of individuals who stopped working is more problematic.

The results of our study indicate that, at this stage, the most suitable area for using the labor of pensioners is the nonproduction sector. Thus, there are 15.3 women of retirement age per 100 women employed in municipal and domestic services, 7.5 pensioners [women] per 100 female hospital attendants and nurse's assistants, 3.5 women of retirement age per 100 women working in trade and public eating facilities.

In the white-collar category, the following jobs are continued the most often after retirement age: office clerks (10.2 men/100, 2.5 women), planning department workers (6.6 and 2.8, respectively) and medical workers (2.4 and 5.7).

Against the background of the above data, employment of pensioners in industry is striking in the minimal figures (see Table). Thus, there are only 0.8-0.9 pensioners per 100 people working in machine-building and metal-working industries. However, specialists have proven that the labor of pensioners is profitable and that involvement of pensioners in industrial production yields a considerable increase in national income (G. A. Popov and others).

However, with advance in age under conditions of a concentrated work day, there is a decrease in physical capacities and professional work capacity under the influence of the combined effect of industrial factors, and this

compels the pensioner to retire. The questionnaire results show that 11.6% of the pensioners left their jobs due to lack of suitable working conditions. The pensioners agree with regard to possible ways of including them in public production that it would be necessary to shorten the work day and week, increase the number and duration of breaks during a work shift, expand the forms of work that can be done in the home.

Distribution of blue- and white-collar workers of retirement age according to occupation in 1979 (per 100 working in given occupation)

White-collar workers	Sex	Indicator	Blue-collar workers	Sex	Indicator
Engineering-technical personnel	M	1.5	Machine building	M	0.8
	F	1.2	Metal workers	F	0.9
Medical workers	M	2.4	Construction workers	M	0.9
	F	5.7		F	0.6
Planning department workers	M	6.6	Trade, food handling facilities	M	5.6
	F	2.8		F	15.8
Protection of socialist property and public order	M	3.7	Communal services	M	2.6
	F	--		F	3.5
Scientific workers, instructors	M	2.4	Hospital attendants, nurse's assistants	M	5.5
	F	1.7		F	7.5
Clerical workers	M	10.3	Leather workers, furriers	M	3.4
	F	2.5		F	3.3
Totals	M	2.0	Totals	M	1.1
	F	2.5		F	4.2

These causes make it necessary to have age and sex-related specialization of labor, adaptation of production and work schedule to the capabilities of the aging organism, development of sectors and types of activity where the labor of pensioners would be efficient.

We should also mention the social significance of housework, since this makes some time free to young people for self-education and meeting their spiritual needs. A study of employment of the elderly and aged in housework revealed that women are more active than men. Virtually all of the interrogated elderly women (91.2%) participate in keeping house, and about half (48.8%) take care of grandchildren. The indicators for men are 11.2 and 21.1%, respectively.

Our study of the reasons for discontinuing work, as well as possibility of retaining an active life-style at retirement age revealed that health is one of the main factors limiting employment. This reason was indicated by 53% of the questioned pensioners.

The data of our study revealed that the older age group is heterogeneous in health status. With age, not only the overall indicators of morbidity, but their qualitative aspect show a rise, there is a change in proportion of acute and chronic diseases, and accumulation of chronic pathology.

The morbidity level in older population groups is determined by diseases of the eye, ischemic heart disease, cerebrovascular lesions, essential hypertension, chronic diseases of the liver and gallbladder, as well as inflammatory and destructive changes in major articulations.

Individual evaluation of physical condition of the group studied enabled us to divide all of those observed into groups and consider them from the medical and social points of view. The first and second groups consisted of healthy and essentially healthy individuals (18%) who do not require constant medical supervision and can be viewed as a potential group to build up the national economy, particularly in the area of services.

The individuals in the third group (two-thirds of those surveyed) have some chronic disease or other and, under certain conditions, could have a beneficial effect on formation of a labor potential. For them, both socio-industrial (favorable working conditions, material incentives and interest, etc.) and medical measures (regular medical supervision, prompt treatment and others) are required.

Thus, the level of employment of pensioners in the national economy is formed by a complex interaction between medical, social and economic factors. The mechanism of their effects is diverse, and it requires further investigation. The problem of employment of the elderly population must be solved in an integrated [complex] fashion, with involvement of various departments, agencies and services, primarily medical workers, hygienists and representatives of social security agencies.

The planning of measures to increase labor activity of the elderly population must be based on effective dispensary supervision of this group and wise job placement. Social security agencies must activate work pertaining to attracting pensioners to jobs by means of broad dissemination of information about possible areas in which they could work. Establishment of a special center, where all information would be concentrated about pensioners who are unemployed but who wish to work, about enterprises where their labor could be used would raise the employment rate in this group and permit optimum use of their work capacities.

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## SUCCESSFUL CHILDREN'S POLYCLINIC IN KIEV

Moscow IZVESTIYA in Russian 4 Jan 83 p 3

[Article by IZVESTIYA staff correspondent S. Tsikora, Kiev, in column "The High Duty of the Physician": "For the Sake of the Children's Health"]

[Text] Not without reason is it said: health is everything. Naturally, questions of medical care of the population in the full sense of the word are vitally important for each of us. In readers' letters delivered by mail to us daily there are many describing with gratitude and warmth the self-sacrificing work of medical scientists, physicians and nurses. There are also encountered, however, instances of a different attitude of medical workers to their professional duty.

Today IZVESTIYA tells about the workdays of the Kiev Polyclinic, which has grown up in a new area of the city. About how a Moscow student found her vacation in service of the people and became a fine surgeon. And, finally, correspondence from Smolensk presents facts testifying to the clearly negligent performance of official duties, the callous attitude to patients of certain health-care workers.

On the left bank of the Dnepr among tall buildings, in the center of a new housing unit with the poetic name of Berezhnyaki, a children's polyclinic has been constructed. It was built according to the typical plan. During development it was not thought of as a model-demonstration polyclinic nor as a base for the faculty of a medical institute. However, in two years it nevertheless did become a model polyclinic, one of the best in the city. Suffice it to say that, in the district served by the polyclinic, of 100 children up to one year of age 25 have never once been ill. And this is a high indicator of the effectiveness of the prophylactic work.

"We give special attention to children of preschool age," said the head physician of the polyclinic A. Shelipova. "If the health of a child of under three years is not strengthened, his body not hardened, it becomes far more difficult to resist diseases at an older age."

The children's hospital in Bereznyaki is concerned with the health of nearly 43,000 children. Their parents are workers and employees of the Kiev factories Arsenal, Radioizmeritel', Radiozavod and others. The polyclinic has concluded agreements with many of these factories for sponsored assistance by factory groups to the physicians. Incidentally, in Kiev, as in the entire republic, this is a wide-spread practice.

The sponsors assisted the new polyclinic in obtaining medical equipment and in finishing the building.

The polyclinic has a hall for therapeutic physical culture. I had occasion to witness how the charges of the kindergartens of several enterprises did gymnastics here with effort and obvious pleasure. In the polyclinic's pool, hours are assigned for the kindergartens of the factories when the children take a building-up course under the observation of a physician.

Experience shows: however excellent the hospitals and consulting rooms are, however modern the technology coming to the aid of the physician, the specialist has been and remains decisive in the organization of therapeutic-prophylactic work. His training and his relationship to the matters at hand decide everything.

I made an inquiry at the Kiev City Health Department: in the past year there has not been a single complaint about the work of the children's polyclinic of Darnitskiy Rayon. And here is another not unimportant fact characterizing the work of this institution: of the 50 participating pediatric physicians, 10 specialists have been certified as in the first category.

"We take cases in 16 medical specialties," says the polyclinic's head physician. "Our work routine has been devised such that when parents come to us with a child they always receive qualified medical care. During working days, reception lasts from 8 am to 8 pm, on Saturday, from 0900 to 1700 hours, and two consulting rooms of physicians on duty are open on Sundays and holidays. All house calls to an ill child are made on the same day."

About 2,500 babies are born annually in the district served by the polyclinic. Their care begins long before their birth. We are not just talking about the traditional contacts of female consultations with the polyclinic or the examination of the newborn by the district pediatrician while still at the maternity home. The polyclinic also has an active school for future mothers, where they learn the art of caring for a baby and acquire the habits of prophylaxis and care for its health. The milk kitchen works without interruption, daily supplying to distribution points 6,500 high-calorie dietetic meals.

I stress: Kiev has more than a few excellent children's therapeutic institutions. The experience of physicians working in the Bereznyaki housing unit is notable in that even here, in an area of new structures, where the life of the residents has just gotten started, a children's service can be organized at the highest level.

## MAKING OF A YOUNG SURGEON

Moscow IZVESTIYA in Russian 4 Jan 83 p 3

[Article by S. Tutorskaya, Moscow, in column "The High Duty of the Physician": "Vocation"]

[Text] Ol'ga Yur'yevna Mironova is 30 years old, she works at the surgical clinic of the 61st Moscow City Hospital. If her length of service is counted from the day when she was listed with the clinic as a house-surgeon, she has now been here for six years. But in actual fact much longer.

...Whence do such quiet girls with soft voices get this unbending perseverance? This courage, which, it would seem, is not at all for them, quiet, feminine... Perhaps you have had occasion to meet such women? The girl grows up in the family. The relatives are heartened by an early interest in serious reading, by successes in school. The time comes and she applies in medicine, as do many of the same age. She enrolls. And...simultaneously joins a hospital staff as a night attendant. Nor for a month, but in earnest.

Why, for the earnings? No, there is sufficient at home. The mother, a microbiologist, is dumbfounded: this is madness, to make such a life for oneself: duty at night, the institute during the day, and a hard institute at that. Love for medicine the mother could understand. But this is the first "adult" step....

This is how Ol'ga arranged her life at the age of seventeen. At the personnel department of the 61st Hospital she was told: night attendants are much needed in the surgical block. And she went.

Surely, this can be called a true calling. No fear--during the very first night they operated, and what she saw so moved Ol'ga that she was not able to doze even for a minute when an hour of rest was given. From this night, there was nothing more important for her than that which surgeons do in the white silence of the operating room.

She "attended", that is to say performed the duties of a mere attendant, for the first year. It need not be stated that she had no student holidays. In the second year her duties expanded. During intensive work the surgeons often did not have enough surgical nurses. The girl, who was quick to learn everything, studied surgical instrumentation and even knew how to prepare for the surgeon everything necessary for a large or small operation. During the third term she was already working as a surgical nurse.



Ol'ga performed the first independent operation while studying in the sixth term of the institute. This was already an entirely new phase in her life: at the institute she met her fate--Viktor. They married, and when studying in the fourth term they had a baby girl.

Thanks to mother, thanks to the clever mother-in-law--they supported the new family as soon as they were able. All together raised the baby. Motherhood made Ol'ga more mature, wiser and responsible.

And now the unforgettable day--this was September 1--when the head surgeon said: "well now, stand at the table and I will assist..." The patient was a young chap of about 20 years with an appendicitis. Ah, and how excited she was when she made the last suture!

No one was surprised when after finishing the institute Doctor Mironova applied for work at the same clinic. There was much here that attracted her. The fact that she could study under such prominent surgeons as G. Lukomskiy and A. Blyakher. Also, the organization of affairs itself pleased her. There are four surgical departments in the 240-bed clinic. In the departments are several teams of physicians, and each team specializes for a specific type of operation--pulmonary, stomach, bile ducts, vascular and others. Moreover, a "sequence of interest" is not only possible but is also desirable. And with that inexhaustible thirst for knowledge that animates Ol'ga, she, of course, grasped at this opportunity.

Six years of work as a physician... Any other young specialist in this time has not yet, as is said, "hatched from the shell", has not yet defined himself. Ol'ga Yur'yeva can do very complicated operations. Among them, for example, is stomach resection. Half a century ago a surgeon was supposed to sleep a whole day before such an operation. In order, so to speak, to gather strength and be up to his task.

The delicate women with small hands does not need such a "warm-up" for a resection. And the other day she successfully operated on a patient with the most severe knife wound. She herself thus recalls this: "Yes, they somehow quickly, nicely managed. The whole team worked splendidly." Serezha, who was brought in barely alive, has already been released and feels fine.

Here, in the clinic, they say that for a surgeon to be trusted with the responsibility for night duty, for the reception of new patients during the night, he must be trained and educated--after the institute--for approximately seven years. In the nighttime, "Emergency" brings in the greatest diversity of patients, while the diagnostic possibilities--laboratory, X-rays--are limited. And considerable experience is needed, intuition is needed and that power of observation which permits the surgeon to make a correct diagnosis on the slightest symptoms. And to decide quickly--is an emergency operation necessary or not. Very much depends upon these first minutes. Ol'ga Yur'yevna could be trusted with the work of a responsible surgeon after only two years. Of course, this is a new heavy burden.... But in this instance it could with full justification be said that one's own burden is not heavy.

To find oneself. To make oneself necessary to people. To be a professional, a true master in one's sphere. Who during youth has not dreamed of this? But does each strive for the goal so selflessly, subordinating to it everything else? Can each so joyfully, without a shadow of fatigue, perform his duty daily to the end? This is not given to everyone. I speak with Ol'ga Yur'yevna, I hear the stories of her patients about her: "Surprisingly attentive, never causes pain for no reason. From early morning already in the ward, and how sensitive! Her hands are remarkable...." I hear all this and I think. I think how happily this turned out, that a capable girl with a great character and with pure thoughts passed the brilliant school of the oldest medical VUZ in the nation--the First Moscow Medical Institute imeni I. M. Sechenov. She continues in still another university--the human and practical training under senior comrades, primarily the clinic's supervisor Professor Lukomskiy. Here there exists that unwritten tradition, by which you run to your seriously-ill patient, leaving guests, the theater, after putting the baby to bed.... Not for nothing does Professor Lukomskiy say: "The concept of the 'end of the working day' does not exist in this clinic. There is a clear definition--the start of the working day. And not one physician thinks of going home if the patients do not permit it...." The older generation of surgeons, having implanted itself, its experience and heart into the youth, is, in general, content: the succession will be secure. And the successors themselves think about this also.

"You know, what a fine girl has come to us," says Ol'ga Yur'yevna, "she is a student, her name is Tanya Prokhorova. This is our third year of duty together. She wants to know absolutely everything, there is no such thing as menial work for her. And so good and tender with the patients--she attends to all, picks up any procedure and everything goes well with her. She and I are on duty the day after tomorrow at night. Come and I will introduce you.

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## MISMANAGEMENT OF VILLAGE HOSPITAL NEAR SMOLENSK

Moscow IZVESTIYA in Russian 4 Jan 83 p 3

[Article by IZVESTIYA staff correspondent R. Bikmukhametov, Smolensk Oblast in column "The High Duty of the Physician": Why Did the 'Skoraya' Not Arrive?"]

[Text] Resident of the village of Ryazanovo in Smolensk Rayon, invalid of the Great Fatherland War, Yakov Trofimovich Matveyenko, felt bad and telephoned the rayon central hospital to send for the "Skoraya promoshch" [the emergency aid service].

"What is wrong?" asked the nurse on duty.

"My heart skipped a beat, little daughter, and also my war wounds are acting up. Please send the 'emergency'" requested the veteran.

"There is no vehicle right now; they are all on call. When they are available we shall report. Wait...."

However, Yakov Trofimovich did not wait for the call nor, especially, the sanitary vehicle. The next day he made it to the hospital by himself, on a passing truck.

"That's how it goes," thought Matveyenkov, "four kilometers to Ryazanovo by asphalt--a stone's throw away, and not only of the five sanitary vehicles could be sent." He went to the Executive Committee of the Stabna Village Soviet and told everything to chairman Mikhail Ivanovich Pavlov, who only spread his hands in helplessness.

No, the executive-committee chairman can by no means be accused of indifference to the villagers' inquiries. Not once and not twice have people come to or called the executive committee and complained about the deficiencies of the medical service and head physician Dol'nikov. Several times Mikhail Ivanovich attempted to discuss this question at a meeting, but the head physician simply ignored all invitations and has not appeared at the executive committee. Even when the people's deputies of the village of Zakharino addressed to the head physician an inquiry as to when a medical worker will appear at their first aid post, Dol'nikov did not deign to answer them.

Boris Ivanovich has worked for only one year as the head physician of the Central Rayon Hospital, and in various instances a good dozen complaints have been received concerning him. But Dol'nikov is, so to speak, under no obligation by this.

Whatever deficiencies there were in the work of the hospital before him, these have remained. Although the hospital has experienced specialists, there is no real organization, none of the proper conscientiousness. It is only because of this that the incident with war veteran Matveyenkov could happen.

When I began talking with patients it became clear that they do not even have a place to wash--neither bath nor a shower. This is hardly an insoluble problem. But the head physician is not up to it, he is busy: he is building....

Work is in full swing on the grounds of the hospital complex. They are building, but not a children's wing, which is so needed. For an entire year a house has been under construction, actually a mansion of nearly 100 square meters...for the head physician. Here Boris Ivanovich has spared neither effort, nor time, nor energy. For several months a private mansion has been erected, while a children's department, whose construction is being postponed from year to year, is still lacking. Comrades from the people's control committee, the residents of Stabna and even the medical workers suggested that the new building be remodeled for the children's department, while the head physician was offered a fine apartment in an excellent house at Zhukovskiy State Farm. The farm management readily agreed to this. But Dol'nikov decisively brushed this option aside and moved into the new dwelling. And the rayon authorities, strangely, resigned themselves to the illegality committed by the head physician.

All this again caused justified anger in the state-farm workers and specialists and the residents of Stabna. However, a surprising spinelessness with respect to Dol'nikov is shown in both the rayon executive committee and in the oblast health care department. Perhaps they consider him irreplaceable. Or, has the medical service improved under him? Absolutely not, judging by the flood of complaints. Is it not time to institute order?

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CONFERENCE OF BALTIC REGION TRAUMATOLOGISTS

Vilnius SOVETSKAYA LITVA in Russian 20 Nov 82 p 2

[Text] EL'TA, Vilnius, 19 Nov 82--The Fourth Conference of Baltic republics' traumatologists and orthopedists completed its work today. Scientists from Estonia, Latvia and Lithuania participated in the conference together with noted specialists from Moscow, Leningrad, other fraternal republics and from abroad.

Even though specialized trauma-orthopedic services were initiated in the Baltic only after the war, great successes have been achieved in this area. Thus, in medical establishments of Soviet Lithuania alone, thirty-six trauma-orthopedic sections are in operation which are capable of treating more than 1500 patients simultaneously. Seven trauma units are in operation where specialized outpatient services are provided.

At the conference, a great deal of attention was devoted to issues of trauma treatment and medical rehabilitation of patients.

Participating in the work of the conference were V. Baltrunas, chief of the Department of Science and Educational Institutions of the Central Committee of the Lithuanian Communist Party, I. Platukis, minister of Health of the republic and other senior party and Soviet workers.

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## BRIEFS

CARDIOVASCULAR AND ONCOLOGICAL DISEASES--Twenty years ago scientists at six USSR medical research centers set out to ascertain with mathematical precision the causes, incidence and progress of cardiovascular and oncological diseases. The results of this experiment have been compiled under the title "The cycle of work on the geographical pathology of cardiovascular diseases and malignant tumors with a view to prevention." Systematic studies were carried out in a number of cities of the USSR in the European republics, and also in Georgia, Central Asia, Siberia, the Baltic, Northern Caucasus, the Caspian region and in the North. Expeditions were undertaken to areas of higher incidence of the diseases, studying age, sex, and ethnic origin factors contributing to the diseases. As a result of preventive measures, the prevalence of cancer among women has been reduced in Georgia. In areas with a high rate of cancer of the esophagus (Kazakhstan, Uzbekistan and Turkmenia), the number of those afflicted has also begun to decrease. As part of the research, data relating to 42,000 patients suffering from arteriosclerosis were studied and so-called risk factors--of which there are some three dozen--were ascertained. The place of residence was one of the lesser known risk factors. A.M. Vihert, corresponding member of the Academy of Medical Sciences says that it was revealed that arteriosclerosis, which is the cause at present of approximately 80 percent of cardiovascular diseases, progresses differently in different geographic regions. It is most pronounced in the European part, in cities most affected by conditions of modern industrial society--Riga, Moscow, and Kharkov. It is least pronounced in Central Asia, even in big cities. Siberian towns hold a position somewhere in the middle between these extremes. The presence of different ethnic groups has made it possible to ascertain that, for instance, in Central Asia the local population suffers considerably less from arteriosclerosis than Russians living there. They are also less affected than the Russian population living in the European part of the USSR. This applies also to Yakutsk, where arteriosclerosis is less pronounced in the local population than in settlers. [Text] [Tashkent International Service, in Uzbek 12 Dec 82] 1840

FUNDS FOR UZBEK HEALTH SERVICES--The funds in the Uzbek SSR budget for safeguarding the health of the Uzbek people will be increased to about 800 million tange (approximately 160 million rubles) next year. This information was made public by Minister of Finance Vali Muratkhodzhayev in his address at the

recent plenum of the Uzbek Supreme Soviet. The number of doctors serving in Uzbekistan is more than 50,000. When considered on the basis of population ratio, this figure is higher than the figures in the capitalist countries in western Europe. One of the most important social tasks in the Soviet Union-- that is to say, making medical services available to people both in the cities and in rural regions--is being realized successfully. Medical treatment services in the Soviet Union are free. [Text] [Tashkent International Service, in Uzbek 12 Dec 82] 1840

## TOXICITY AND RADIOPROTECTIVE EFFECTS OF SOME SULFUR-CONTAINING PROTECTIVE AGENTS WHEN GIVEN TOGETHER BY MOUTH

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 2 Aug 79) pp 746-749

[Article by Ye. V. Suroyegin]

[Text] The work of a number of authors established that there is a limit of protective action in radioprotective agents, i.e., absence of enhancement of radioprotective effect with increase in dosage of an agent [1-3]. This limit, which was named the saturation effect [4], can be exceeded by means of combined use of protective agents [5], and this applies not only to compounds referable to different classes [6-8], but agents with similar structure and mechanism of action [9-12]. The limit of protective effect is then established at a new, higher level [13]. The main obstacle to clinical use of protective agents and formulas is their toxicity [7, 8]. For this reason, a need arises to search for combinations whose toxicity diminishes, as compared to the toxicity of the different components [14-15]. In particular, it has been found that glutathione and cysteine diminish the toxicity of some amino thiols [16, 17], while cysteine demonstrates antagonism in the toxic effects of cystaphos and cystamine [18]. It is very important to mention that, when cysteine and glutathione are given together with other sulfur-containing protective agents there is enhancement of the radioprotective effect of combinations [19, 20]. It was previously established [21] that toxic effects are summated when AET is given with cystaphos and APAETP [aminopropyl aminoethyl thiophosphate], but when cystaphos and APAETP are combined no additivity of toxic effects is observed. The radioprotective effects of these agents are summated, regardless of whether or not one observes summation of toxicity.

The above-mentioned experiments were conducted with intraperitoneal injection of protective agents. There are absolutely no data in the literature concerning the distinctions of toxic and radioprotective effects of sulfur-containing agents when given together by mouth. Our objective here was to investigate this matter.

#### Material and Methods

Toxicity of different agents and combinations thereof was determined in 425 male mongrel mice weighing 20-25 g. We tested the radioprotective effect on 500 (CBA×C57BL)<sub>F</sub><sub>1</sub> hybrid mice. When testing the toxicity of combinations, the agents were used in isotoxic amounts, i.e., equal shares of LD<sub>50</sub> of each. LD<sub>1</sub>



and LD<sub>50</sub> were calculated by the method described in [22]. The radioprotective effect of different agents and combinations thereof was evaluated according to DRF [dose reduction factor] of intestinal and general death. The mice were exposed to a wide range of doses, from 7.0 to 16.5 Gy, at a dose rate of 1.05 Gy/min. Animals that died within 5 days after irradiation were considered to have died of the intestinal syndrome. In addition, we took into consideration overall deaths due to the intestinal and bone marrow syndromes between the 1st and 30th days. DRF of protective agents and combinations was calculated on the basis of medial lethal doses in experimental and control groups. LD<sub>50/5</sub> and LD<sub>50/30</sub> were calculated on a computer using a program elaborated by V. I. Suslikov [22]. The protective agents and combinations were given intragastrically in a volume of 0.2 ml 1 h before irradiation. The dosage of protective agents given separately constituted one-quarter of LD<sub>50</sub> in one case and one-half in the other. In the triple combination, the dosage of agents was one-third the dosage when these agents were used separately, thus constituting one-twelfth and one-sixth of the LD<sub>50</sub> of each agent.

We calculated the therapeutic index,  $TI = LD_{50}/AU_{DRF1,2}$ , to determine the breadth of therapeutic effect of agents and combinations [AU--active units]. The therapeutic index is not sufficient for definitive evaluation of relative safety of a given compound [23]. For this reason, in addition to the therapeutic index, we also calculated the risk index,  $RI = LD_1/AU_{DRF1,2}$ .

#### Results and Discussion

The data listed in Table 1 show that additivity of toxic mechanisms is demonstrable when AET is used together with cystaphos or APAETP. The LD<sub>50</sub> of the complexes was obtained when using the agents in doses constituting about one-half the LD<sub>50</sub> of each ingredient. With use of APAETP together with cystaphos, we observed complete independence of their toxic effects. We had to use the full medial lethal doses of each agent to obtain 50% death of animals with combined administration, rather than one-half the LD<sub>50</sub> of each protective agent, as would have been the case of additivity of effects.

Table 1. Toxicity of APAETP, cystaphos and AET [aminoethylisothiuronium] given by mouth separately and in combination

AGENT	LD <sub>50</sub> MG/KG	SHARE OF LD <sub>50</sub> OF EACH AGENT IN COMBINATION
APAETP	842,4	—
CYSTAPHOS	2684,4	—
AET	1556,7	—
APAETP + AET	1247,5	0,52
CYSTAPHOS + AET	2035,7	0,48
APAETP + CYSTAPHOS	3045,5	1,10
APAETP + CYSTAPHOS + AET	2185,9	0,43

As a result of absence of additivity of toxic effect of APAETP and cystaphos, the LD<sub>50</sub> of a triple combination was obtained with doses of the agents exceeding one-third the LD<sub>50</sub> of each when given separately. The obtained mixture (APAETP + cystaphos + AET) was found to be 1.2 times more toxic than cystaphos, 2.6 times less toxic than APAETP and 1.4 times less toxic than AET. Thus, on the basis

of these results, it can be stated that the previously established patterns of toxicity of these agents when given together parenterally [22] were generally confirmed for intake by mouth as well. The difference between parenteral and per os administration is that, in the latter case, there was complete, rather than partial, independence of toxic effect of APAETP and cystaphos.

Table 2. Radioprotective effect, therapeutic index (TI) and risk index (RI) with separate and combined use of protective agents given by mouth

AGENT	DOSE, MG/KG	INTESTINAL DEATH			OVERALL DEATH		
		DRF	TI	RI	DRF	TI	RI
APAETP	203	1,25	5,7	3,2	1,18	3,8	2,2
	406	1,28			1,50		
CYSTAPHOS	681	1,20	3,9	3,0	1,21	4,0	3,1
	1362	1,27			1,43		
AET	393	1,24	5,0	3,8	1,24	4,6	3,5
	786	1,34			1,55		
APAETP + CYSTAPHOS + AET	425	1,30	8,6	6,2	1,20	5,1	3,7
	850	1,43			1,40		

Table 2 lists data on radioprotective efficacy of the different agents and combination of all three. For APAETP and cystaphos, the DRF showed virtually no increase in intestinal death when the dosage was doubled, whereas with regard to AET there was a tendency toward some increase of this parameter. DRF of the triple combination used in a low dosage with supralethal irradiation was somewhat higher than the same parameters for the protective agents individually. Doubling the dosage of agents in the combination was associated with substantial enhancement of the radioprotective effect, which was considerably greater than that of APAETP, cystaphos and AET. Consequently, in the case of intake by mouth, the limit of protective effect established for individual protective agents can be exceeded by using them in combination. At the same time, we were impressed by the fact that both the therapeutic index and risk index of the triple combination were significantly higher when using radiation doses that elicit intestinal death than the same parameters for APAETP, cystaphos and AET.

We observed somewhat different patterns of radioprotective effect of the agents when we examined data pertaining to overall deaths. First of all, we should mention that, with increase in dosage of agents, there was also increase in radioprotective effect of both individually used agents and the triple combination. Of the agents studied, AET was the most effective. DRF of the triple combination was somewhat lower than DRF for APAETP, cystaphos and AET. But, when we compared the safety indicators, as in the case of intestinal death, the combination demonstrated some advantages over the agents when they were used separately.

These facts lead us to conclude that, in the case of supralethal doses of radiation that elicit intestinal death, the limit of protective effect of protective agents develops sooner than with doses that elicit the bone marrow syndrome. One can raise the limit or radioprotective effects in the case of supralethal irradiation by giving by mouth a combination of the three sulfur-containing protective agents, APAETP + cystaphos + AET. In the

case of irradiation in doses eliciting the bone marrow syndrome, the tested combination is not superior in separately given agents, with regard to radio-protective effect, but is still safer than the individual agents.

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## STUDY OF RADIOPROTECTIVE ACTIVITY OF NEW BETA-AMINONITRILES

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 16 Aug 79) pp 750-752

[Article by R. A. Babayev, R. M. Akhmedov, S. I. Mekhtiyev, T. A. Kuliyeu and M. I. Dzhubarov, Institute of Physiology imeni A. I. Karayev, Azerbaijan Academy of Sciences, and All-Union Scientific Research Technological Institute of Recovery and Processing of Low Molecular Olefins, Baku]

[Text] Aminonitriles are bifunctional compounds, on the basis of which one can obtain valuable products of organic and petrochemical synthesis [1, 2]. They can be used as intermediate products to prepare physiologically active substances, drugs, plastics, etc. It should be noted that, while recovery of  $\beta$ -aminonitriles by means of interaction of acrylonitrile with amines is widely practiced, there is only limited information about interaction of the latter with acrylonitrile homologues--crotononitrile and metacrylonitrile. Previously, a method was developed for recovery of  $\beta$ -aminobutyronitriles [3,4] and  $\beta$ -aminoisobutyronitriles [3, 5, 6]. It was interesting to investigate the possible radioprotective properties of  $\beta$ -aminobutyronitriles and  $\beta$ -aminoisobutyronitriles, since there is information to the effect that such bifunctional compounds have radioprotective action and physiological activity [1, 7], and that one could expect synthesis of new compounds with more marked radioprotective activity by means of appropriate changes in the carbon chain in this class of compounds.

We submit here the results of experiments conducted to test radioprotective properties of some new, chromatographically pure aminonitriles [Table).

#### Material and Methods

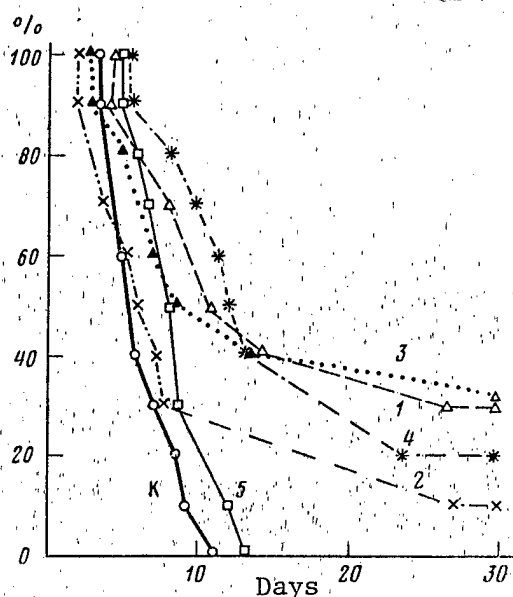
Experiments were conducted on 60 male white Wistar rats weighing 160-180 g. The animals were divided into six groups. They were given intraperitoneal injections of the tested compounds in the following concentrations 30 min before irradiation: 50 mg/kg  $\beta$ -aminobutyronitrile, 350 mg/kg  $\beta$ -allylamino-butyronitrile,  $\beta$ -diethylaminobutyronitrile,  $\beta$ -butylaminoisobutyronitrile and  $\beta$ -benzylaminoisobutyronitrile. All compounds, with the exception of the first one (which dissolved in distilled water) were prepared with peach oil.

The animals were exposed once to total-body radiation delivered from an RUM-17 unit with the following technique: 180 kV, 15 mA, skin to focus distance 30 cm without tube, filters 0.5 mm Cu + 1.0 mm Al, dose rate 0.86 Gy/min; total

radiation dose 6.9 Gy. We assessed efficacy of the compounds on the basis of survival rate [percentage] among irradiated animals on the 30th day and mean survival time. Experimental results were submitted to statistical processing [8, 9].

Survival rate and mean survival time of rats given  $\beta$ -aminonitriles intraperitoneally 30 min prior to exposure to 6.9 Gy radiation

COMPOUND	CHEMICAL FORMULA	SURVIVAL %	P	MEAN SURVIVAL TIME, DAYS	P
CONTROL, NO COMPOUND		0	—	$6,4 \pm 0,75$	—
$\beta$ -AMINO BUTYRONITRILE	$\text{CH}_3-\text{CH}-\text{CH}_2-\text{CN}$   $\text{NH}_2$	30%	$<0,001$	$17,3 \pm 3,3$	$<0,001$
$\beta$ -ALLYLAMINO BUTYRONITRILE	$\text{CH}_3-\text{CH}-\text{CH}_2-\text{CN}$   $\text{NH}-\text{CH}_2-\text{CH}=\text{CH}_2$	10%	$<0,02$	$12 \pm 3,54$	$<0,1$
$\beta$ -DIETHYLAMINO BUTYRONITRILE	$\text{CH}_3-\text{CH}-\text{CH}_2-\text{CN}$   $\text{N}(\text{C}_2\text{H}_5)_2$	30%	$<0,001$	$16,3 \pm 3,73$	$<0,02$
$\beta$ -BUTYLAMINO ISOBUTYRONITRILE	$\text{C}_4\text{H}_9\text{NH}-\text{CH}_2-\text{CH}-\text{CN}$   $\text{CH}_3$	20%	$<0,1$	$15,6 \pm 2,92$	$<0,01$
$\beta$ -BENZYLAMINO ISOBUTYRONITRILE	$\text{C}_6\text{H}_5-\text{CH}_2-\text{NH}-\text{CH}-\text{CN}$   $\text{CH}_3$	0	—	$3,8 \pm 0,9$	—



Survival of rats exposed to radiation in a dosage of 6.9 Gy and given different  $\beta$ -aminonitriles  
X-axis, postradiation days; y-axis, survival, %

- K) control
- 1)  $\beta$ -aminobutyronitrile
- 2)  $\beta$ -allylamino butyronitrile
- 3)  $\beta$ -diethylamino butyronitrile
- 4)  $\beta$ -butylamino isobutyronitrile
- 5)  $\beta$ -benzylamino isobutyronitrile
- 6) irradiated control

## Results and Discussion

As can be seen in the Figure, control animals died by the 11th postradiation day (mean survival time  $6.4 \pm 0.75$  days). Analysis of the data shown in the Figure and Table revealed that, of the tested compounds, there was some radioprotective activity in  $\beta$ -aminobutyronitrile and  $\beta$ -diethylaminobutyronitrile, which increased survival rate to 30% and mean survival time to 10.9 and 9.9 days, respectively; the increase in survival rate and mean survival time was statistically reliable ( $P < 0.001$  and  $P < 0.001$ , respectively, for  $\beta$ -aminobutyronitrile,  $P < 0.001$  and  $P < 0.02$  for  $\beta$ -diethylaminobutyronitrile). As can be seen in the Table, experimental animals died mainly between the 3d and 15th days, i.e., during development of acute radiation sickness. Autopsy revealed hemorrhages in parenchymatous organs and gastrointestinal tract of all animals that died.

The experimental data warrant the assumption that the tested compounds, which are referable to a new class of aminonitriles, may be promising radioprotectors if appropriate structural changes are made, and they could have a pronounced protective effect with use of optimum routes of administration and dosage. As for the mechanism of action of these compounds, apparently one should proceed from their possible role as antioxidants, since some aminonitriles synthesized on the basis of acrylonitriles do have antioxidant activity [10].

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STUDY OF RADIOPROTECTIVE PROPERTIES OF OPTICAL ISOMERS OF  
S-(2-AMINOPENTYL)ISOTHIUREA IN EXPERIMENTS ON MAMMALS AND CELLS IN VITRO

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 5 Nov 79) pp 752-755

[Article by E. Ya. Grayevskiy [deceased], M. I. Yanushevskaya, A. A. Mandrugin, I. V. Nekrasova, E. I. Buyeverova, Ye. V. Bragina, S. M. Khomutov and V. M. Fedoseyev, Institute of Developmental Biology imeni N. K. Kol'tsov, USSR Academy of Sciences, Moscow]

[Text] It is known, from analysis of data in the literature, that the optical activity of compounds could influence their radioprotective effects in a number of instances. Thus, while the D and L forms of cysteine (experiments on mice and *E. coli* [1, 2]) were equally effective, optical isomers of S-(2-aminobutyl)-isothiurea dihydrobromide had different effects on their radioprotective activity: the D form was 2-3 times more effective than the L form [3-5].

In view of the sparsity and contradiction of data, our objective here was to determine the comparative radioprotective activity of D, L forms and racemate of S-(2-aminopentyl)isothiurea dihydrobromide (2-APentT) in experiments on mammals, isolated cells of Ehrlich's ascites carcinoma and Chinese hamster fibroblasts cultivated in vitro.

#### Material and Methods

We tested radioprotective activity of 2-APentT on F<sub>1</sub>(CBA×C57B1/6) mice 12-14 weeks of age weighing 18-22 g. We used more than 800 mice in the experiments. The animals were exposed to <sup>60</sup>Co γ-rays in a dosage of 258 mC/kg at a dose rate of 1.38 mA/kg. Survival rate and mean survival time (MST) of animals that died within the observation period (30 days) served as criteria of radiation damage. The agents were given subcutaneously in 0.5 ml saline, in maximum tolerated dosage.

In the in vitro experiments, we used a hyperdiploid strain of Ehrlich's ascites carcinoma (EAC) on the 7th day of its growth in the abdominal cavity of mice. Tumor cells were removed from the abdominal cavity, eluted twice in saline, diluted to a concentration of  $2 \cdot 10^7$  cells/ml, then incubated with D and L forms, and with 2-APentT racemate for 15 min at a temperature of 37°C, after which they were exposed to x-radiation in a dosage of 206.4 mC/kg. Radiation technique: 15 mA, 190 kV, dose rate 0.26 mA/kg, filters 0.5 mm Cu + 1.0 mm Al.

After irradiation, saline was used to remove the agent from cells; and they were injected intraperitoneally to intact mice at the rate of 1 ml per mouse ( $2 \cdot 10^7$  cells). Nonirradiated cells and cells exposed to radiation without using the agent served as a control. After 24 h, the animals were sacrificed; smears were prepared of ascites tumor cells, they were fixed in methanol and stained according to Feulgen, with additional light green staining. We assessed radiosensitivity of EAC on the basis of number of cells with chromosome aberrations (bridges and acentric fragments) at the late anaphase--early telophase stages of the first postradiation mitosis, and according to total number of cells that grew in the abdominal cavity of mice within 3 days after injection of cells. For this purpose, we flushed cells from the abdominal cavity with saline on the 3d day of tumor growth and counted them in a Goryayev chamber.

We also conducted experiments on a culture of Chinese hamster line BII dii FAF-28, clone 431 cells. The cultures were grown in medium 199 mixed with Eagle's medium (1:1), with addition of 20% inactivated calf serum and antibiotics (streptomycin and penicillin, 50 U/ml of each) at a temperature of 37°C in an atmosphere containing 6% CO<sub>2</sub>. The cells were exposed to x-rays in a dosage of 77.4 mC/kg under the same conditions as EAC cells. The compounds were added to cells 15 min prior to irradiation. After exposure, the compound was washed off, cells were treated with trypsin and inoculated in 100 cm<sup>3</sup> separating flasks (400 cells per flask). Effectiveness of inoculation constituted 80-85% in the control under our experimental conditions. Radiosensitivity of cells was assessed by the number of colonies that grew on the 7th day of cultivation. The colonies were stained with methylene blue. We used standard methods for statistical processing [6]. The agents were synthesized in the department of radiochemistry of the Chemistry Faculty of Moscow State University. Separation into optical antipodes was effected by the method in [7].

## Results and Discussion

As established in preliminary experiments, the maximum tolerated dose of D, L forms and 2-APentT racemate constituted 0.5 mg/mouse. Testing of the radioprotective effect of 2-APentT racemate in this dosage on mice revealed only a tendency toward enhancement of the animals' radioresistance, according to both survival rate and mean survival time of animals that died. D and L forms were ineffective. At the same time, the test product, AET [aminoethylisothio-uronium] (10 mg/mouse) raised the survival rate to 95% in the same experiment (Table 1). Such low radioprotective activity of 2-APentT racemate is probably related to the substantially greater toxicity of such compounds for animals, as compared to AET (20 times greater). For this reason, we conducted our subsequent studies on isolated cells.

Studies of toxicity of DL, D and L forms of 2-APentT for EAC cells revealed that, with all tested doses (from 0.3 to 1.4 mg/ml suspension), they did not elicit cell damage: they did not depress tumor growth and did not increase the number of cells with chromosome aberrations. Addition of these agents to irradiated tumor cells was also nontoxic to EAC cells. To test the radioprotective activity of the DL form of 2-APentT, we used a dosage that was equimolar to AET [8] in experiments on isolated cells, and with the D and L forms we used half the racemate dosage.

Table 1. Effect of racemate, D and L forms of S-2-APentT and AET on survival rate and mean survival time of mice exposed to radiation in a dosage of 258 mC/kg ( $^{60}\text{Co } \gamma$ )

COMPOUND AND DOSAGE, MG/MOUSE	NUMBER OF ANIMALS	SURVIVAL, %	MEAN SURVIVAL TIME, DAYS
NONE	59	0	8,5±0,3
DL, 0,5	40	10,0±4,7	11,1±0,4
D-, 0,5	40	0	9,4±0,6
L-, 0,5	40	0	6,9±0,3
AET, 10	20	95,0±5,0	1 DIED ON 4 TH DAY

Table 2. Effect of D, L forms and racemate of S-2-APentT on radioresistance of Ehrlich's ascites carcinoma cells exposed to radiation in a dosage of 206.4 mC/kg

INDICATOR OF RADIORESISTANCE	NO COMPOUND	DL-	D-	L-
TUMOR GROWTH ON THIRD DAY	46,0±0,5 n=3**	55,1±1,5 n=3	54,8±1,7 n=3	54,8±1,0 n=3
CELLS WITHOUT CHROMOSOME ABERRATIONS	39,8±1,8 n=8	53,9±1,8 n=8	55,1±4,8 n=8	49,9±2,8 n=8

\*Percentage of nonirradiated control.

\*\*n--number of experiments.

Table 3. Effect of D, L, DL forms of S-2-APentT on survival of Chinese hamster fibroblasts cultivated in vitro

OBJECT	NO COMPOUND	DL-	D-	L-
NONIRRADIATED CELLS	100±4,0 n=10	99,1±2,3 n=10	99,2±4,1 n=10	99,1±3,9 n=10
IRRADIATED CELLS, DOSAGE 77.4 MC/KG	32,0±4,2 n=10	60,0±2,1 n=10	55,0±3,8 n=10	60,0±2,9 n=10

We see from the data listed in Table 2 that D, L and DL forms of 2-APentT have radioprotective activity, as determined by both the number of cells without chromosome aberrations and tumor growth. According to these indicators, the D and L forms were equally effective, with regard to radioprotection, with 2-APentT racemate.

The tested agents were also nontoxic for Chinese hamster fibroblasts up to a dosage of 4.2 mg/ml, which is 3 times greater than the equimolar dose of AET. In experiments conducted to test the radioprotective activity of the compounds, we selected a dosage analogous to the one used in experiments with Ehrlich's ascites cells, i.e., equimolar to AET (1.4 mg/ml). The data listed in Table 3 indicate that the tested compounds demonstrated distinct radioprotective

activity. This was manifested by the drastic increase in number of colonies (almost double). It should be noted that, as in the experiments with EAC, the efficacy of different isomers was the same and did not differ from racemate.

Thus, it was established that S-2-APentT has radioprotective activity on isolated cells, similarly to other analogues of AET [3, 9-12]. The D and L forms of S-2-APentT do not differ in magnitude of radioprotective effect on cells, and this can probably be attributed to the absence of appreciable differences in metabolism of these compounds in cells. The absence of a significant radioprotective effect in the DL form of S-2-APentT on animals is probably due to the high toxicity of this compound, as indicated by a comparison of the radioprotective dosage of this compound and AET.

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## EFFECT OF BETA-MERCAPTOETHYLAMINE ON SURVIVAL OF MICROORGANISMS DIFFERING IN RADIOSENSITIVITY

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 12 Jun 79) pp 758-762

[Article by Ye. A. Kuznetsova and L. A. Fomenko]

[Text] There have been descriptions of the possibility of increasing survival of prokaryote, eukaryote and whole organism cells by means of various chemicals, in particular, sulfhydryl radioprotective agents [1-3]. However, the existing conceptions concerning the mechanisms of radioprotective activity of these agents are hypothetical for the time being. Recently, hypotheses have been expounded and experimentally confirmed that there is a link between the radioprotective activity of an effective radioprotective agent,  $\beta$ -mercaptoethylamine (MEA) and functional activity of DNA repair systems, as well as increase in volume of repair [4, 5]. Our objective here was to investigate the protective effect of MEA on bacterial cells differing drastically in efficiency of repair after exposure to factors that induce repair processes:  $\gamma$  and UV [ultra-violet] radiation, treatment with the chemical mutagen, N-nitroso-N-methylurea (NMM).

## Material and Methods

In our experiments, we used cells of microorganisms that have good repair systems: *Escherichia coli* K-12W 3110 (received from the Institute of Epidemiology and Microbiology imeni N. F. Gamaleya), *Bacillus subtilis* 168 (*leu*<sup>-</sup>, *met*<sup>-</sup>) (obtained from V. D. Filippov, Institute of General Genetics, USSR Academy of Sciences), *Bac. stearothermophilus* (obtained from L. G. Loginova, Institute of Microbiology, USSR Academy of Sciences), *Micrococcus radiodurans* 1700 (from the Institute of Biophysics, Czech Academy of Sciences, Brno). *E. coli* K-12, *B. subtilis*, *B. stearothermophilus* (optimum growth temperature 62°C) and *M. radiodurans* were cultivated in liquid nutrient media to the late logarithmic phase of growth ( $5 \cdot 10^7$ - $1 \cdot 10^8$  cells/ml). *E. coli* and *B. subtilis* were grown on mineral medium with peptone and glucose added [6], *B. stearothermophilus* on a synthetic medium with saccharose [7] and *M. radiodurans* on the medium indicated in [8].

The cells were gathered by centrifugation, resuspended in 0.067 M phosphate buffer, pH 7.2, and half the suspension was incubated with MEA in an end concentration of 50 mM at 37°C on a rocker for 20 min. The cells were exposed

to  $\gamma$ -rays ( $^{137}\text{Cs}$ ) on ice, using an LMB unit and dosage of 0.53 Gy/s (3200 rad/min). A BUV-15 lamp served as the source of UV light (mainly at 254 nm). UV irradiation was performed in Petri dishes 90 mm in diameter at a dose rate of 18 erg/mm<sup>2</sup>/s. NMM treatment was effected at 37°C on a rocker for 100 min, using different concentrations of NMM. After irradiation or treatment of cells with NMM, the suspension was diluted more than 100-fold in the same phosphate buffer and inoculated in Petri dishes with appropriate solid medium. *E. coli*, *B. subtilis* and *B. stearothermophilus* colonies were counted after 1 day and *M. radiodurans* colonies after 2 days.

## Results and Discussion

The results of the first series of experiments revealed (Figure 1) that, after exposure to  $\gamma$ -radiation, survival of cells of microorganisms differing in radiosensitivity, with the exception of the extremely radioresistant *M. radiodurans*, increased when the cells were treated with MEA (50 mM) prior to irradiation; DRF [dose reduction factor] at 37% survival constituted 1.5, 2.3 and 3.6 for *E. coli* K-12, *B. subtilis* and *B. stearothermophilus*, respectively. *B. stearothermophilus* and *E. coli* cells were similar in radiosensitivity in the case of  $\gamma$ -radiation; however, the degree of protection by MEA was higher for the extremely thermophilic microorganism, *B. stearothermophilus*. These data indicate that the same concentration of radioprotective agent has a different protective effect on different bacteria. While a maximum radioprotective effect was observed on thermophilic bacteria, no protection was demonstrable in the highly radioresistant cells of *M. radiodurans*.

It was demonstrated on *E. coli* [4] that effective radioprotection with MEA can be demonstrated only in cells with good repair system. According to the results of our experiments, no protection was found in *M. radiodurans* cells, although these bacteria do have a good repair system. It can be assumed that the cells of this strain have such a well-balanced and functionally active DNA repair system that they do not need additional protection of a protective agent. It is assumed [9] that the radioprotective activity of MEA is based on its effect on the process of DNA repair by slowing down endo-exonuclease degradation of  $\gamma$ -damage. It is known that bacterial DNA is degraded much more in repair from UV damage than after exposure to  $\gamma$ -radiation [10].

However, there is no information in the literature about manifestation of the effect of MEA with regard to survival of UV-irradiated bacteria or DNA repair. For this reason, experiments were conducted to determine whether MEA would have a protective effect on UV-irradiated bacteria. It was assumed that this agent could affect degradation of DNA in UV-irradiated cells. As shown by the results of these experiments, MEA demonstrated a protective effect only on *B. stearothermophilus* exposed to UV, but not for *E. coli* and *B. subtilis* exposed to UV (Figure 2). The presence of protective effect of MEA on *B. stearothermophilus* cells exposed to UV, unlike other bacterial species, suggests that there may be induction of a process similar to the one that functions in cells exposed to  $\gamma$ -radiation, when these cells are exposed to UV radiation.

We also tested the possibility of manifestation of protective effect of MEA on *B. stearothermophilus* and *B. subtilis* cells treated with the chemical mutagen, NMM. Under the effect of NMM, along with single-strand and double-stranded

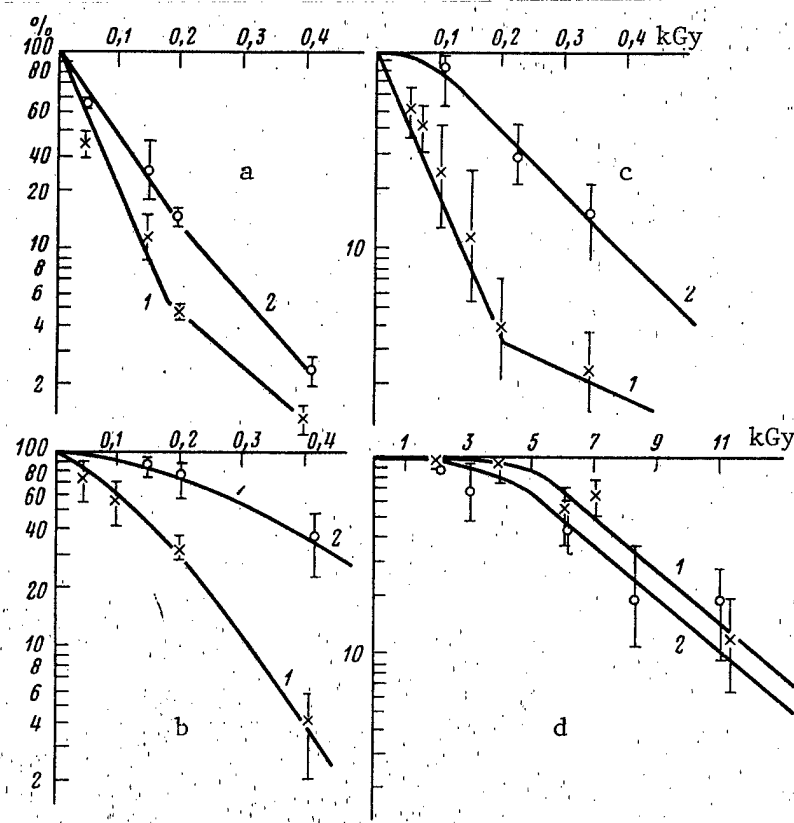


Figure 1. Survival curves for  $\gamma$ -irradiated *E. coli* K-12 (a), *B. subtilis* 168 (b), *B. stearothermophilus* (c) and *M. radiodurans* 1700 (c). X-axis, radiation dose, kGy; y-axis, survival on a logarithmic scale, %

- 1) not treated with MEA
- 2) before irradiation the bacteria were incubated for 20 min with 50 mM MEA at 37°C

breaks in DNA, there were damaged bases of the 0-6 methylguanine and 3-methyladenine type, the process of repair of which is also associated with degradation of injured regions [11]. The results indicate that the protective effect of MEA after treating cells with the mutagen is also demonstrable in *B. stearothermophilus* cells (Figure 3) but not in *B. subtilis*. It should be noted that the *B. stearothermophilus* strain manifested considerable resistance to NMM, according to the criterion of survival, as compared to *B. subtilis*. There was even an increase in survival of *B. stearothermophilus* with a concentration of 0.1 M NMM, which can apparently be attributed to induction of SOS repair with such concentrations of deleterious agent [12], or inhibition of DNA-degrading enzymes as a result of their carbamoylation with high concentration of NMM [13].

Thus, the submitted experimental results are indicative of the great efficacy of MEA protection with regard to survival of thermophil *B. stearothermophilus* bacteria, demonstrable not only with  $\gamma$ -radiation, but other factors, UV and NMM.

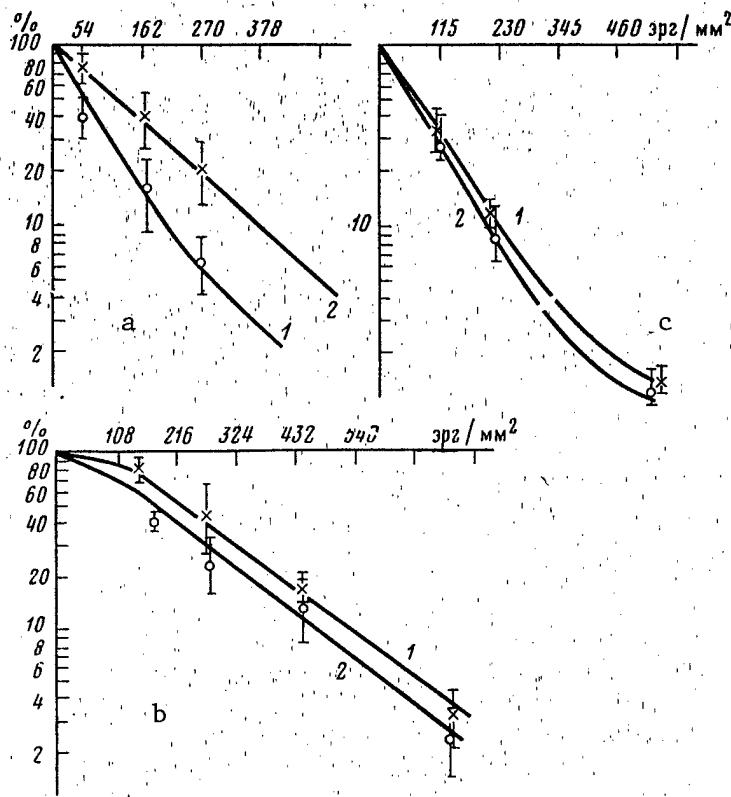


Figure 2. Survival curves for UV-irradiated *B. stearothermophilus* (a), *B. subtilis* (b) and *E. coli* (c). X-axis, radiation dose, erg/mm<sup>2</sup>; y-axis, survival on logarithmic scale, %

- 1) not treated with MEA
- 2) before irradiation, bacteria were incubated with 50 mM MEA at 37°C for 20 min

What could be the cause of this phenomenon? As we know, thermophilic microorganisms are characterized by a high rate of metabolic processes [7], and under the effect of high temperatures there is constant formation and repair of heat damage in DNA. Appearance of apurine sites is one of the types of such damage [14]. Indeed, a powerful system of DNA degradation and resynthesis was discovered in *B. stearothermophilus* cells [15]. Apurine sites also appear in DNA with exposure to ionizing radiation [18]. It can be assumed that MEA is instrumental in stabilizing the genome of thermophils by restraining DNA degradation in the sites of apurination and apyrimidination, and consequently creates conditions for fuller repair of damage in DNA. According to the hypothesis expounded by Bresler and Noskin [9], MEA delays the effect of incision endonucleases, modifying damage in DNA, which results in prevention of formation and accumulation of lethal double-stranded breaks. In addition to damage induced by UV and NMM, there is a considerable number of apurine sites in the DNA of thermophil bacteria exposed to UV and treated with NMM, i.e., under identical conditions of use of physical and chemical agents on thermophilic and mesophilic bacteria, considerably more damage develops in the DNA of thermophils. For this reason, in the course of repair of the many



injuries induced by UV light or NMM to apurine sites as well, there will probably be accumulation of double-stranded DNA breaks, which are a lethal event for the cell [16, 17]. Hence it is understandable that, if MEA affects the process of DNA degradation, it apparently inhibits expressly the endonucleases specific to the apurine sites, thereby causing a decrease in number of double-stranded breaks appearing in DNA of *B. stearothermophilus* after exposure to UV light and treatment with NMM.

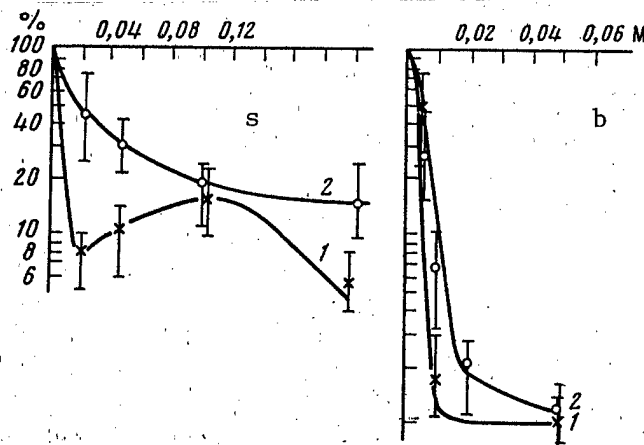


Figure 3. Survival curves for *B. stearothermophilus* (a) and *B. subtilis* (b) treated with different concentrations of NMM for 100 min at 38°C. X-axis, NMM concentration, M; y-axis, survival on logarithmic scale, %

- 1) not treated with MEA
- 2) before NMM treatment bacteria were incubated with 50 mM MEA at 37°C for 20 min

In the future, we plan to investigate the effect of MEA on molecular processes of bacterial DNA repair, in particular in *B. stearothermophilus* exposed to deleterious factors ( $\gamma$ , UV radiation, NMM).

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CSO: 1840/72

## INVESTIGATION OF POSTHYPOXIC RADIOPROTECTIVE EFFECT IN EXPERIMENTS WITH RATS

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 11 Nov 79) pp 762-765

[Article by R. B. Strelkov, N. G. Kucherenko, I. D. Vlasova, O. I. Kurochkina and A. Ya. Chizhov, Scientific Research Institute of Medical Radiology, USSR Academy of Medical Sciences, Obninsk, and Hospital No 1, 4th Main Administration under RSFSR Ministry of Health, Moscow]

[Text] There have been publications in recent years [1-2] submitting data that are in contradiction with the previously established correlation between decline of  $pO_2$  in radiosensitive tissues and increase in radioresistance of the organism [3-6]. A substantial argument against such a link is the posthypoxic radioprotective effect demonstrated by some authors, which is demonstrable in frogs and mice after repeated exposure of animals to hypoxia followed by irradiation with normal  $pO_2$  level in tissues [7-9]. Since the presence of a posthypoxia radioprotective effect is not only a theoretically interesting phenomenon, but could have great applied implications, particularly at the present time when graded hypoxia has been proposed and is used as a radiomodifying agent in clinical practice [10-12], we deemed it necessary to continue investigation of the posthypoxic radioprotective effect in experiments on more highly organized animals--rats.

## Material and Methods

Experiments were conducted on 386 male rats weighing  $220 \pm 30$  g. Hypoxia was produced by lowering oxygen pressure in a Schroeder Co. pressure chamber  $0.45 \text{ m}^3$  in size. The rats were "raised" at the rate of 25 m/s to an "altitude" of 10,000 m and kept there ( $P = 263.9$  gPa, oxygen content 5.4 vol.%) for 30 min. After returning the animals to normal atmospheric conditions, they were exposed to radiation 30 min, 3 h and 3 days later delivered by a  $^{60}\text{Co}$  GUB-20000 unit at a dose rate of 0.4 Gy/min. Absorbed dose constituted 7, 8.5 and 10 Gy. An LP-7 polarograph (CSSR) was used to monitor  $PO_2$  level in rat subcutaneous tissue, which adequately reflects  $PO_2$  in hemopoietic tissues [13-14]. Polarographic analysis was performed on 10 nonirradiated animals. An open platinum electrode, 300  $\mu\text{m}$  in diameter (PL-0 grade of platinum, 99.999% pure) served as the active electrode. A calomel electrode served as the reference electrode. Before each test and immediately after it, the electrode was calibrated in physiological NaCl solution equilibrated with atmospheric air at  $37^\circ\text{C}$ . We recorded survival for 30 days after irradiation and mean survival time of

animals that died. We counted formed blood elements in controls and animals exposed to 8.5 Gy radiation on the 1st, 3d, 9th, 15th, 21st and 29th days after exposure (3 rats at each time). In an additional series of experiments, 20 rats were irradiated in a special container with hypoxic gas mixture containing 5.4% oxygen.

### Results and Discussion

It was established by polarography that the PO<sub>2</sub> level in subcutaneous tissue of animals constituted a mean of 53.9±3.5 (46.9÷45.6) gPa under normal atmospheric conditions. This parameter declined with "ascent" as rarefaction increased in the pressure chamber. Thus, at an "altitude" of 5800 m, PO<sub>2</sub> constituted 27.7±1.9 (23.9÷31.4) gPa, and at 8000 m it was 4.8±0.5 (3.7÷5.9) gPa. At an "altitude" of 10,000 m, pO<sub>2</sub> dropped to 0.5±0.26 (0÷1.0) gPa and remained in this range throughout the exposure period.

Survival rate and postradiation survival time for rats at different stages of the posthypoxic period\*

EXPERIMENTAL CONDITIONS	SURVIVAL, %		
	RADIATION DOSE, Gy		
	7	8,5	10
IRRADIATION			
NORMOXIC CONDITIONS	83,3±6,2 (36)	23,8±6,6 (42)	10,0±6,7 (20)
HYPOXIA (5.4% O <sub>2</sub> )	—	80,0±8,9 (20)	—
30 MIN AFTER HYPOXIA	80,0±8,9 (20)	23,3±7,7 (30)	10,0±6,7 (20)
3 H AFTER HYPOXIA	60,0±12,6 (15)	40,0±6,3 (30)	10,0±6,7 (20)
3 DAYS AFTER HYPOXIA	45,6±8,5 (22)	36,7±8,8 (30)	15,0±8,0 (20)
NONIRRADIATED CONTROL	100,0 (10)	100,0 (10)	100,0 (10)
EXPERIMENTAL CONDITIONS	SURVIVAL TIME, DAYS		
	RADIATION DOSE, Gy		
	7	8,5	10
IRRADIATION			
NORMOXIA	20,7±0,9 (6)	15,7±0,8 (32)	11,3±1,2 (18)
HYPOXIA (5.4% O <sub>2</sub> )	—	24,5±1,08 (4)	—
30 MIN AFTER HYPOXIA	13,0±0,8 (4)	12,5±1,1 (23)	9,8±0,8 (18)
3 H AFTER HYPOXIA	26,5±1,1 (6)	14,4±0,9 (18)	8,8±1,1 (18)
3 DAYS AFTER HYPOXIA	23,7±1,8 (12)	15,0±1,2 (19)	8,8±1,1 (17)
NONIRRADIATED CONTROL	—	—	—

\*Number of animals used indicated in parentheses.

It should be noted that under the described hypoxic conditions ("altitude" of 10,000 m), 10 to 20% of the rats died in different series of experiments. With "descent" and return of animals to normal atmospheric conditions (21%

oxygen),  $pO_2$  level in subcutaneous cellular tissue reverted to base values within 3-5 min. In some cases, we observed an increase in oxygen tension, as compared to initial  $pO_2$ . However, within 25-30 min oxygen tension in subcutaneous tissue of all animals did not differ from  $pO_2$  level recorded before the experiment. Thus, after creating brief hypoxia once, within 30 min we already failed to demonstrate posthypoxic changes in  $pO_2$  level by the polarographic method.

Postradiation survival of experimental animals at different stages of posthypoxia, as well as mean survival time of rats that died after irradiation, are listed in the Table.

According to the submitted data, we failed to demonstrate a posthypoxic radioprotective effect with delivery of radiation in the tested doses (7, 8.5 and 10 Gy). It was not recorded either at the immediate stage after hypoxia (within 30 min) or at the longer term, 3 h and 3 days later. When these animals were submitted to irradiation, there was a tendency toward deeper and longer leukopenia than in animals irradiated under control conditions. We recorded a statistically reliable radioprotective effect, with regard to survival rate (probability integral "T" = 5.1), in the 20 animals used in the additional series of tests, which were irradiated in the presence of hypoxia induced by a hypoxic gas breathing mixture. In this group of animals, leukopenia developed at the same time as in control rats; however, its severity and duration had some tendency toward decline, as compared to changes in blood of rats irradiated in the posthypoxia period.

Thus, experiments on rats maintained under hypoxic conditions for 30 min ( $P = 263.9$  gPa, "altitude" 10,000 m, 5.4 vol.%  $O_2$ ) failed to demonstrate a posthypoxic radioprotective effect when the animals were irradiated 30 min, 3 h and 3 days after discontinuing hypoxia, when  $pO_2$  level in tissue was normal. However, when rats were irradiated in a hypoxic state (ambient oxygen content 5.4% corresponding to an altitude of 10,000 m), there was appreciable increase in the animals' radioresistance. The data obtained under these experimental conditions confirm the existing conception that there is a correlation between decline of  $pO_2$  level in body tissues and increase in radioresistance.

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RADIOPROTECTION OF DNA BY HETEROCYCLIC DERIVATIVES OF S-(AMINOALKYL)  
ISOTHIUREAS

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80  
(manuscript received 23 Aug 79) pp 676-682

KONDAKOVA, N. V., MANDRUGIN, A. A., RIPA, N. V., SAKHAROVA, V. V. and  
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Ministry of Health, Moscow; Chemistry Faculty, Moscow State University  
imeni M. V. Lomonosov

[Abstract] In vitro comparative studies were conducted on the radioprotective effects of 2-amino-2-thiazoline (AT), 2-amino-5,6-dihydro-4-n-1,3,-thiazine (ADT), S-(2-aminoethyl)isothiurea (AET), and mercaptoethanolamine (MEA) on high molecular weight bovine thymic DNA exposed to gamma irradiation. At concentrations of  $\geq 10^{-3}$  M, AT and ADT were found to protect the DNA from the damaging effects of irradiation; at equimolar concentrations, both compounds were equally effective. However, their effectiveness increased with the radiation dose which suggested that the effectiveness was probably due to binding with DNA, a conjecture supported by the results of melting temperature studies. Both agents, ADT and AT, were less efficient as radioprotectors than AET and MEA. Figures 5, references 20: 12 Russian, 8 Western.  
[73-12172]

UDC 577.391:661.879

EFFECTIVENESS OF IRON IN ENHANCING PLUTONIUM-239 ELIMINATION FROM BODY

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80  
(manuscript received 1 Oct 79) pp 683-687

SHVYDKO, N. S., RUSHONIK, S. I., POPOV, D. K. and VOROZHTSOVA, L. N.,  
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of Health

[Abstract] Iron citrate (13.3 g) was administered to albino male rats pre-treated with plutonium-239 citrate solution ( $11.1 \times 10^4$  Bq) to evaluate the

efficacy of iron in enhancing elimination of plutonium-239 from the body. Initially, iron citrate was given 2.5 h after radioisotope administration and thereafter at weekly intervals for the 83 day period of evaluation. During the first 2 days iron administration promoted urinary elimination of the radiostope (1.99% of total administered dose in experimental animals vs. 0.8% in control rats); subsequently, there were no significant differences in renal elimination. Iron was determined to be most effective in enhancing gastrointestinal elimination of plutonium-239, particularly during the first 20 days. Total cumulative excretion (stools + urine) during the 83 day period represented 60.3% of the radioisotope load in the experimental rats and 36.8% in the control rats. Analysis of kinetic curves indicated that elimination could be further accelerated by administration of iron citrate at 1-3 day intervals rather than weekly. Figures 2, references 2 (Russian). [73-12172]

UDC 577.391:576.809.7

#### EFFECTS OF LONG-TERM IRRADIATION ON ANTIBODY PRODUCTION IN MICE

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 19 Mar 79) pp 714-718

KIRILLOVA, Ye. N. and LUZANOV, V. M.

[Abstract] Male CBA mice were treated for three months on a daily basis with either tritium oxide (via drinking water) or subjected to Cs-137 external gamma irradiation to evaluate the effects of equivalent doses (4.1 Gy total dose) on antibody response to sheep erythrocytes in terms of hemolysin production and splenocytic plaque- and rosette formation. The results indicated that both regimens were immunosuppressive on the basis of all the tests with respect to this antigenic stimulus. However, on an overall basis, internal radiation from tritium oxide was 1.27-times as immunosuppressive as external gamma irradiation. Figures 2, references 21: 12 Russian, 9 Western. [73-12172]

UDC 577.391:612.119

#### LATE REPOPULATING EFFICIENCY OF HEMOPIETIC CFU AFTER LONG-TERM DAILY IRRADIATION

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 2 Aug 79) pp 719-723

MUKSINOVA, K. N.

[Abstract] Investigations were conducted on the effects of prolonged Cs-137 gamma irradiation of BALB/c mice (50 R/day; 1000 or 2000 final cumulative dose) on the repopulating efficiency of bone-marrow, colony-forming units (CFU)



derived from these mice in lethally irradiated recipients. Tests with CFU obtained one to nine months after the maximum cumulative dose showed a decrease in both the numbers of the CFU and in their repopulating effectiveness. Some recovery of activity and numbers was evident with time, but the suppressive effects of radiation were evident throughout the period of observation and there was direct dose-effect correlation. Figures 1, references 11: 5 Russian, 6 Western.  
[73-12172]

UDC 577.391:612.418

CORRELATION BETWEEN MORPHOLOGIC AND PHYSIOLOGIC CHANGES IN MURINE SPLEEN AFTER  $\gamma$ -IRRADIATION

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 16 Aug 79) pp 724-728

MALKINA, R. M. and TUZHILKOVA, T. N.

[Abstract] Studies were conducted on the effects of gamma irradiation of C57B1/6 female mice on splenic morphology and physiology. Depression of karyocyte counts, weight loss, K<sup>+</sup> depletion and Na<sup>+</sup> elevation were noted within 24 h of exposure to doses ranging from  $258 \times 10^{-4}$  to  $2322 \times 10^{-4}$  C/kg. Irradiation within  $(2580-5160) \times 10^{-4}$  C/kg range resulted in noticeable lymphocyte depletion and other changes within 15 min. These findings demonstrated that morphological and functional alterations were induced by essentially equivalent doses of radiation  $((258-516) \times 10^{-4}$  C/kg) and, at the lower spectrum of irradiation, occurred within three days. Figures 2, references 11: 10 Russian, 1 Western.  
[73-12172]

UDC 577.391:661.879

QUANTIFICATION OF RESIDUAL LESIONS FOLLOWING LONG-TERM EXPOSURE TO TRITIUM OXIDE OR EXTERNAL  $\gamma$ -IRRADIATION

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 19 Feb 79) pp 772-775

VORONIN, V. S.

[Abstract] Residual radiation damage was evaluated in terms of LD<sub>50/30</sub> determinations for male Wistar rats subjected to intragastric tritium oxide administration (37 or 370 kBq/day; 5X/week; 6 mo.) or to Cs-137 gamma irradiation to give equivalent daily and total cumulative dose. Evaluation of the resultant data showed that compensatory recovery of animals on the

370 kBq/day regimen was more rapid than on the 37 kBq/day routine, presumably because a threshold dose needed to trigger repair processes was not reached as soon. Furthermore, the damage due to internal tritium radiation (370 kBq/day) exceeded almost two-fold that induced by external gamma radiation because of earlier and more extensive injury to the hemopoietic and immune systems.

References 11: 6 Russian, 5 Western.  
[73-12172]

UDC 577.391:612.119

#### MEASURED BLOOD LOSS AND RAT RADIOSENSITIVITY

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 10 Apr 79) pp 776-778

KOROTKEVICH, A. O. and LASTOCHKINA, Ye. M.

[Abstract] Investigations were conducted to determine the effects of handling and blood loss on radiosensitivity of male Wistar rats exposed to  $2064 \times 10^4$  C/kg Cs-137 gamma irradiation. The mortality for control rats was 80%, and that for animals from which 1 ml of blood was obtained one and two weeks before irradiation and 2 h after irradiation (together with daily weighing) was 40%. Animals subjected only to weighing or from whom smaller blood samples were obtained (0.1 ml) showed intermediate mortality figures (50 and 63%, respectively). These observations indicate that removal of ca. 7% of the circulating blood volume potentiates radioresistance in this strain of rats. Figures 1, references: 8 (Russian).

[73-12172]

UDC 577.391:539.124:591.477

#### EFFECT OF TOTAL-BODY EXTERNAL IRRADIATION WITH KRYPTON-85 $\beta$ -PARTICLES IN COMBINATION WITH X-IRRADIATION ON THE RAT SKIN AT ELEVATED AMBIENT TEMPERATURE

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 13 Jul 79) pp 790-792

RAPPOPORT, I. A. and SUDAKOVA, V. O.

[Abstract] Outbred male rats were employed in a study to determine the temperature effect in X-ray and beta-ray (krypton-85) induced dermatitis. The results showed that at room temperature X-rays ( $129 \times 10^{-4}$  C/kg) were without effect; beta particles (30.5 Gy) induced localized dry dermatitis in 40% of the animals at room temperature and at 36°C. Combination of X-rays and beta particles at room temperature yielded both localized (30% of animals) and dissemination (10%) dry dermatitis. Combined irradiation at 36°C evoked disseminated dry dermatitis

in 40% of the exposed animals, and localized moist dermatitis in another 40% of the experimental rats. The potentiating effects of elevated temperature appear to be due to enhanced metabolic activity of the skin as indicated by increased permeability (neutral red test). Figures 1, references 14 (Russian). [73-12172]

CHANGES IN TIME FACTOR IN RELATION TO INTERVAL BETWEEN DOUBLE UNIFORM AND NONUNIFORM IRRADIATION OF RATS

Moscow RADIOBIOLOGIYA in Russian Vol 20, No 5, Sep-Oct 80 (manuscript received 28 May 79) pp 704-708

AVETISOV, G. M.

[Abstract] Regression analyses were performed to determine time factors for double uniform and nonuniform gamma irradiation of outbred rats on the basis of fractionated and unfracionated doses producing equivalent lethal effects. Evaluation of data for situations in which the first dose was equal to  $2/3$   $LD_{50/30}$  of one exposure with a mortality of 0-10% showed that the numerical value of the time factor increased as the biological effect (mortality) decreased. Under the experimental conditions employed, the numerical values for the time factors in uniform and nonuniform irradiations did not exceed a value of three. However, on the basis of midpoint mortality the limiting numerical value was two. Figures 1, references 12: 11 Russian, 1 Western. [73-12172]

PSYCHIATRY

PSYCHIATRY SYMPOSIUM

Tallinn SOVETSKAYA ESTONIYA in Russian 20 Nov 82 p 2

[Article under by-line of Estonian Telegraph Agency: "Soviet-Finnish Symposium"]

[Text] The fifth Soviet-Finnish Symposium on Current Questions in Psychiatry was held on 17-18 November in Tallinn. It was organized by the USSR Ministry of Health, the Estonian SSR Ministry of Health and the All-Union Scientific Research Institute of Forensic Psychiatry imeni Professor V. P. Serbskiy. The symposium was opened by G. Morozov, academician of the USSR Academy of Medical Sciences, board chairman of the All-Union Scientific Society of Neuropathologists and Psychiatrists and director of the Scientific Research Institute of Forensic Psychiatry imeni V. P. Serbskiy.

The achievements of modern psychiatry and the problems of diagnosing such diseases as schizophrenia were discussed.

"The symposium was successful," declared Kalle Akhte, the leader of the Finnish delegation, chief of clinical psychiatry of Helsinki University, to the Estonian Telegraph Agency correspondent in connection with the signing of the meeting's joint protocol. "A number of hypotheses were stated whose solution may give encouraging results. The meeting with Soviet colleagues, including such prominent Soviet scientists as Academician G. Morozov and Corresponding Member of the USSR Academy of Medical Sciences, Professor Yu. Saarma from Tartu University (with whom we have collaborated for more than a year), was extremely fruitful."

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