

**International Center  
“Sport of the 21st Century”  
Institute of Quantum Medicine  
Institute of Biophysics**

***«TOWARD LONGEVITY  
AND TOP ACHIEVEMENT IN  
SPORT WITHOUT DOPING»***

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**BIOMEDICAL SUPPORT  
AND QUANTUM MEDICINE OF  
TOP ACHIEVEMENT SPORT**

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## Introduction

At the start of the new millennium, there is the need for a sober look at present-day developments in top achievement sport. The recent 2000 Olympic Games in Sydney prompt an especially serious analysis. It is apparent that the general level of performance of their winners has been significantly lower as compared to the previous Barcelona and Atlanta Games (exceptions are some of swimming disciplines where the progress is largely related to a special wear). The number of undisputable leaders has dwindled at the cost of higher collective results. The physical appearance of athletes shows some change these days - there were less women with a masculine bulk, while muscle of men did not look so artificial as in the previous years. Olympic winners were older than they used to be. However, an intuition-guided approach to the preparation of unarguably talented athletes showed even through top results.

As it was expected, there was a good deal of positive doping tests, with mostly steroids implicated. The testing work was done quietly and efficiently, and the mass media did not relish another exposure: guilty ath-

letes were sent packing without much agiotage.

Understanding a problem and quietly handling it is a key to success. Indeed, the new realities clearly show logical change in philosophies of coaching top-notch athletes and motivate all specialists working in top achievement sport to look for a new concept of training.

We are proud that the motto of our Center "Sport of the 21st Century", "Toward Top Achievement in Sport without Doping", was a watchword of the 1st International Conference on Sport Medical Science and Practice on the Threshold of the 21st Century which worked in Moscow on October 24-26, 2000, immediately after the close of the Olympic Games. The conference's proceedings underscored the increasing role of science and biomedical support of top achievement sport in the poststeroid era of the 21st century, the period of new emerging approaches and concepts. We are sure that their advent for the first time will provide a positive answer as to what big-time sport leaves on balance - health or toll. The new concepts and technologies will help the staying power of athletes not only during pursuit of their careers, but also after their retirement.

Therefore, much time and effort remain to be invested for biomedical knowledge to take a proper place in the formation of an individualized methodology of achieving extra class results and to fit into the general concept of training.

*This book is devoted to  
Sergei Nikolayevich Kustov,  
Merited Trainer of Russia  
(18.01.1960 - 2.10.2000).*

## **1. BIOMEDICAL SUPPORT OF TOP ACHIEVEMENT SPORT**

At the present time, biomedical support of sport has gone beyond its traditional boundaries of sports medicine to acquire numerous new features, primarily an indispensable contribution of science to methodologies of training. This is crucial in top achievement sport which is associated with incredible results and strain close to the limit of possibilities of the human as a species. Achieving a new quality, which is an extra class result sought in the training process, is impossible without medical control of the organism. Because of individual, genotypically determined features, the state of the body can vary at different phases of training in a broad range, one of limits of which is disease. In our experience, even a world record setter may not be in perfect health or may have a symptom complex or even a serious disease. Outstanding athletes should be a pride and gene pool of their nations, and not a show of bad impacts of top level sport on human health. The ill-effects usually result from rule of thumb decisions on effort intensity and other serious errors of method in training. Systematic overstrain and inadequate recovery of the organism, prolonged use

of steroids and other banned drugs, liberal use of a variety of incompatible drugs and food additives typically lead to irreversible abnormalities of organs and systems. These are cardiac and hepatic degeneration, endocrine and metabolic disorders, locomotor and gastrointestinal disease, immunodeficiency, urogenital disorders and others. These abnormalities in turn cause hemodynamic disturbances, mitral prolapse and even myocardial infarction; persistent hepatic enzyme disorders, impairment of glycolytic gluconeogenesis and cirrhosis; impotence, infertility, urolithiasis, cancer and death at an early age. This is a far from exhaustive list of ominous (let alone fatal) costs of methodological errors.

Present-day medical support of top achievement sport should see planned results from the perspective of comprehensive observation of the organism - at an organic, tissue, cellular and even intracellular level with identification of a "shock" organ which is genotypically most vulnerable during physical and emotional strain. Obtaining objective evidence at these levels requires skilled specialists from different biomedical disciplines with knowledge of a particular sport.

Our long-term studies have examined possibilities of enhancing the athletic performance and explored mechanisms of physical and mental fatigue during stress and recovery processes (1, 21, 23). The studies evaluated the role of strain in the onset of disease and its effects on the "shock" organ and the aging process at the cellular level. The aim was to work out a concept of homeostasis correction in athletes during the intensive training (2, 13). We have developed some original or modified preexisting study methods which provided a set of revealing and readily reproducible tests for rapid evaluation and follow-up of the condition of athletes (3, 20).

Follow-up examinations using these tests have shown an individual pattern of response to exercise at different phases of the training process and allowed adjustment or individualization of the training regimen.

An essential part of making the training individual is an adequate pharmacologic and physiotherapeutic correction and immunomodulation of fatigue and recovery processes. This allows adjustment of exercise not only during the specialty training but also during land or gym work aimed to improve strength, speed, endurance and flexibility (4). It also allows one to recommend and control, with account for individual features of the athlete's organism, the use of other sports for improving the performance in the specialty discipline. The tests also provide advice concerning the dietary balance, durations and intensity of training in medium-altitude terrain, the quality of swimming pool and drinking water and sunlight exposure.

Another important aspect of methodological support of training is adaptation to contest conditions on different continents and in different time zones and climates (22). The adaptation is corrected with account for individual, genotypic features of athletes' organism using (a) an apt training method, (b) pharmacologic and (c) physiotherapeutic support relying on findings of systematic follow-up. Insights into the organism provided by observation at different phases of training yield individual regimens of precontest training and maximal use of invested effort during the contest (15).

A crucial task of biomedical support is assisting the athlete in his or her progress to success. Contest is a stressful exposure with significant impacts on the biochemically complex, multifactorial mechanism which underlies physical and emotional fatigue. Knowledge of psychophysiology peculiarities of the athlete, which comes from concrete studies in the training process rather than by inference, backed by pharmacologic and physiotherapeutic care help him or her achieve an appreciably better result.

Biomedical support of the training process and top achievement sport helps homeostasis correction relevant to individuality of the athlete, readjustment of train-

ing and contest strain, health care and rehabilitation, and evaluation of his or her physical potential in a given sport.

The above presented considerations are recapitulated in Chart 1 which shows that biomedical support of the training process and top achievement sport is a multicomponent range whose fragments should be discussed in more detail.

### **1.1. Systemic diagnosis: A clue to an individualized training process and disease prevention in sport**

Athletes are great toilers who live with restrictions and stress for many years. However paradoxically it might sound to a man in the street, the higher is the level of an athlete's conditioning, the smaller is his or her immune reserve and the more prone is the athlete is to abnormalities of various organs and systems. The risk of their onset is higher in the absence of efficient medical control (23).

Priority areas of biomedical disciplines should be determined on which to rely in forming a multicomponent diagnostic complex which allows a systematic and full evaluation of athletes during the hard training for readjusting of workloads and maximizing biologic effects of each practice (see below).

Priority areas of biomedical disciplines:

1. Biochemistry
2. Hematology
3. Cardiology
4. Neurology

5. Immunology
6. Pharmacology
7. Psychophysiology
8. Genetics
9. Physiotherapy
10. Quantum medicine
11. Ultrasound diagnosis
12. Computer technologies
13. Experimental medicine
14. Institution of consultants in different disciplines

The requirements which diagnostic methods of biomedical support of training should meet are their diagnostic value, rapidity, reproducibility in a hospital and training camp setting, and their availability before and after and, sometimes, during a practice.

Therefore, another important requirement of medical support is a state-of-art equipment and availability of highly skilled medical, instructor, biologist and other staff allowing to resolve the most complex task. We will briefly illustrate this.



### **1.1.1. Biochemistry**

The role of biochemical blood and urinary tests is crucial. Analysis of clinical findings depicts the internal state of the athlete's organism, especially changes induced by workloads of different intensity. On the other hand, their comparison with findings of blood, cardiac, neurological and other tests may prompt a readjustment of training intensity. For example, excess blood levels of hepatic enzymes (aspartate transaminase, alanine transaminase), a depressed hemoglobin level or a urinary protein level above 3 g/l concomitant with the dysregulation syndrome warrant a lower training intensity, with the heart rate remaining under 140/min. Relevant drugs are prescribed with follow-up tests. Miscompliance with this recommendation can lead to persistent hepatic cell lysis and, in long-term, glycolysis derangement and liver degeneration. The athlete may present with no symptoms in this period because of the high compensatory potential of the young organism, but he or she will be unable to improve performance.

It should be borne in mind that some biochemical findings of athletes vary in different training periods and

somewhat differ from normal values seen in healthy people. Thus total cholesterol, which eventually contributes to the hormone profile, should not be below 5.5 mmol/l, especially during with hard training when glucose is heavily used up.

Skilled specialists can timely detect any biochemical changes in a training athlete and correct them using a medical or other treatment. Moreover, they can single out and follow-up specific findings and report them to the trainer or the athlete with explanations of their causes and advice of a relevant diet or drug, appropriateness and goals of specific workloads in a particular training period. The specialists must present findings of their studies and explain to trainers how athletes are doing recovery after "crushing" series, help optimize rehabilitation and advise when intensive training should be resumed. In this way only can a new quality of fitness be achieved and sporting results appreciably upgraded by improving the athlete's health.

It is not our task to describe dozens of biochemical indicators which are well known in clinical practice. Change of each of them carries serious messages indicative of the condition of organs, metabolism, etc. They also reflect fitness and even professionalism of an athlete and, certainly, his or her genotypic peculiarities. An example is the testing of lactate dehydrogenase, an enzyme which American specialists have reported to have five versions. Again, the indicators reveal a genotypically determined response and the presence of disease which may be elusive even to a specialist who long observes an athlete. It is very important to timely detect the transition from change to lesion and from health to disease.

Apart from clinical evaluation, other biochemical studies can be of help in elucidation of mechanisms of various diseases and borderline conditions arising during hard training. The studies also provide a measure of effects of drugs on the pathogenetic mechanisms. Original tests are often used in our studies (5,6,7). One is

an erythrocyte sedimentation test developed by Potemkin et al. in 1983 as an indicator of plasma membrane protein lesions and as a method of drug selection for homeostasis correction (8, 9). It is known that a prerequisite for stability of therapeutic and recovery effects is normalization of activity of antioxidant enzymes - superoxide dismutase, catalase and ceruloplasmin which, like porphyrins and their derivatives, have a direct relation to plasma membranes. Their activation indicates stabilization of biomembranes and intensification of cellular metabolism. In addition, porphyrins and ionized calcium affect lipid peroxidation, the activation of which is seen as a universal mechanism of plasma membrane damage, to act on the endothelium derived relaxing factor which softens vascular walls, improving microcirculation (10).

Dozens of other biochemical tests can be offered for use in studies. The need for adding them to known clinical criteria is decided by specialists who conduct serious research essential in biomedical support of top achievement sport. Each athlete is in a sense unique, and an interpretation of changes seen in the state of his or her organism during the long and intensive training process is a difficult practical task, the resolution of which leads to logical success.

### **1.1.2. Hematology**

Blood tests fall into clinical and special categories. Their role in the training of athletes is extremely high. A huge number of methodologies for stimulation of peripheral blood components, primarily erythropoiesis, has been borrowed in sports medicine from practical health care. Specialists and athletes know a variety of blood stimulation techniques. However, such manipulations are often performed intuitively, and are not always valid and beneficial, and sometimes they leave the organism with a serious damage.

A complete blood count has an extremely high diagnostic value; in combination with a range of tests for rapid evaluation of the organism, they allow one to assess the need for some or another approach or procedure and intensity of workloads. For example, a known athlete, Olympic winner, mature man and father of two has shown a world record performance during the camp training after which he returned home. A ten-day stay with the family, with training continued, have left a pale-face of the athlete. Comparison of his red blood tests at a two-week interval showed a Hb of 12.4 as against his

former 16.5, erythrocytes 3.9 as compared to 5.5 and so on. Other tests were the same sad picture. With this in mind, the trainer had to reschedule the training to avoid still worse trouble. The cause was the athlete's self-medication with a potent antimicrobial fluorquinolone drug, tarevid, with which he hoped to prevent infecting his family. However, the drug has more side effects and contraindications than therapeutic effect (24). The result was loss of fitness and the need for prolonged recovery. Therefore, blood tests (hemoglobin, erythrocytes, the color test, reticulocytes) are sensitive to changes in the organism, readily available for follow-up, and give accurate information about the athlete's condition. In combination with other tests, they provide a guide for readjustment of the training process.

If a specialist who follows up an athlete uses special blood tests not for "pundit" but realistic pursuits, they can substantially improve an understanding of mechanisms underlying observed borderline events and prove quite practical.

Knowledge of the condition of cell pools and inferences about precursor cells and hemopoietic depots obtained by methods of special hematology allow, along with other test findings, a judgement on the need for hemopoiesis stimulation by training in mountain terrain, a favorite of many athletes who sometimes resort to it more than once a year. For example, nature blessed an athlete with a higher hemopoietic function, but an unknowledgeable trainer gives him or her an erythrocyte stimulator, such as erythropoietin, which was banned not so long ago, and sends the athlete to train in a medium-altitude mountain area. As a result, all see with surprise the athlete's results to decline despite a huge training work.

This is what is on surface, but internal damage which occurs is a hardest blow to the hemopoietic system from which the athlete cannot recover for many years (18). In addition, excessive strain and a lack of adequate rehabilitation, a situation with which many are

willing to toy when training in mountains, can result in very serious abnormalities. Unfortunately, trainers very often remain uninformed about blood findings of athletes, let alone other tests, after such training.

Our many-year experience of work with known Slovenian women slalom skiers, holders of all possible titles has shown that very serious abnormalities occur in athletes in medium-height mountains. Therefore, specialists involved in biomedical support of top achievement sport should be very meticulous about the need for mountain training of an individual athlete and urge for appropriate readjustment of workloads in mountains if test findings prompt it.

Blood studies are an intergral part of systematic evaluation of athletes throughout the training and in the postcontest period.

### **1.1.3. Cardiology**

Medicine of top achievement sport has long since adopted practical cardiologic methods and has generated ample experience with special techniques of cardiovascular evaluation. Diagnostic value of cardiac tests has much increased over the recent years because of rapid development of computer technologies and a wealth of new diagnostic programs designed by specialists in sports cardiology.

Availability in the country of cardiac research centers of world renown with highly skilled specialists ready to give counseling and practical aid to athletes is also very important.

However, specialists in methodological support of top achievement sport should have a full arsenal of diagnostic programs for evaluation of athletes, who typically have their individual features and their cardiovascular problems (sinus arrhythmia, bundle branch block, aberrant QRS complex, elongated QT syndrome, hypertension, dystonia or even valve prolapse, etc.).

Inappropriate medication (prolonged use of steroids, misuse of incompatible drugs), intuitive plan-

ning of workloads and inadequate recovery, with proneness of the organism to products of energy metabolism, lead to serious cardiac abnormalities.

We often encounter situations which are inordinary on the one hand and expectable on the other - short-term adverse effects of the prolonged intake of steroids and their long-term cardiovascular impacts, such as mitral prolapse coexisting with glycolytic gluconeogenesis derangement, arthrosis, etc. Physiotherapy and medical treatment of these conditions during moderate exercise will be reviewed in the section "Quantum Medicine".

Efficient systemic diagnosis with permanent use of ultrasound, biochemical and hematological work-up (decompensated electrolyte disorders, membrane lesions, see "Biochemistry") helps avert overstrain as a premorbid state. This approach allows optimization of ***the fatigue process, a natural physiologic state of a transient functional imbalance*** which is readily reversible not only by resources of the organism but also by efficient medical care and rehabilitation.

The use of exercise which is not specific for a given sport in paraclinical diagnosis is inappropriate this day, as modern medical support of top achievement sport has an arsenal of original methodologies for use during the controlled intensive training.

The systematic use of ultrasound studies and tests of microcirculation, vascularization, peripheral circulation, the galvanic skin reaction, galvanic skin resistance and other additional criteria combined with the above discussed biochemical and blood tests will broaden the observed picture and will allow specialists to avert a serious disease by adequate medical treatment, physiotherapy and prescribing reasonable workloads. We use in our studies various original methodologies to evaluate stress during the training by ECG and functional tests of the cardiovascular system and by modelling precontest and postcontest conditions.



The systematic follow-up of athletes enables us to identify individual, genotype-related features or acquired abnormalities.

The current state of knowledge allows preventing persistent abnormalities and using controlled exercise, pharmacologic and physiotherapeutic support for adequate rehabilitation.

Cardiologic studies in sport are an intensively evolving area. Combined with increasingly sophisticated computer technologies, progress in other biomedical disciplines and specialist skill, they offer unlimited possibilities in biomedical support of top achievement sport and real assistance to coaches and athletes in designing individual training methodologies and achieving extra class results.

#### **1.1.4. Neurology**

Neurologic examination of athletes is rarely used and is usually reserved for regular health checks. However, studies of the bioelectric activity of the brain are of great value, given the expanding opportunities of its analysis provided by computer technologies. Indeed, electroencephalography reveals close morphologic and functional relationships of heart performance and cerebral rhythms (ejection fraction, left ventricular myocardial contractility and right atrial size are related to voltages of alpha rhythms in almost all leads, while magnitudes of frontal alpha rhythms correlate with right ventricular ejection and with pulmonary arterial blood flow velocity).

EEG evidence should be used in evaluation of an athlete's potential in complex coordination sports and in the follow-up during the training routine and the contest period.

The search for a modern concept of training for top achievement relates to new possibilities for enhancing the performance, primarily by a deeper understanding of workings of the athlete's organism.

Reasonable use of additional methods in this pursuit is one of directions of biomedical support of the training process. Our studies use a range of neurologic tests which with time have become part of diagnostic tools used in sport practice. One of these is functional evaluation of the central nervous system (CNS) using integral criteria which describe functional potential and the state of cerebral homeostasis, a useful adjunct information in different periods of training.

We are deeply convinced that study and extensive use of criteria for functional evaluation of the CNS is a promising line of biomedical support of top achievement sport..

### **1.1.5. Immunology**

The quality of training is affected not only by errors in its methodologic support, which may overlook individuality of athletes, but also by losses incurred by immunodeficiency which occurs during the hard training (12). A training method may prove powerless to influence this condition, and underperformance of athletes during the basic and special training makes their achieving high results unrealistic. The use of banned drugs, including steroids, is especially adverse in terms of immunodeficiency, an expectable occurrence, given that these drugs are used in transplantology to suppress immunity.

In addition, intensive training in itself is a stress which triggers the biochemically intricate, multifactorial mechanism of fatigue. Skeletal muscles act in this situation as a trophic part of the immune system producing glutamine, deficiency of which is a precursor to fatigue (25). Glutamine is necessary for RNA and DNA reprocessing for T cell reproduction. Glutamine deficiency impairs T cell morphogenesis and, during overstrain, depresses immunogenesis. This condition causes serious abnormalities. Without correcting it, specialists are

inevitably confronted by the transition of biochemical systems from normalcy to abnormality. Therefore, for some or another reason ***immunodeficiency is an attribute of intensive training***. Warding it off is an important task of biomedical support of top achievement sport. For this reason the earlier presented Chart 1 gives a special place to immunomodulation which is essential in biomedical support of top achievement sport. We will give a separate section of this book to immunomodulation methodologies.

### **1.1.6. Pharmacology**

Use of any drugs which are not banned in sport rests on full and updated knowledge of the state and individuality of a concrete organism, of tasks of various training periods and cycles, an understanding of kinetics of drugs offered to athletes, their side effects and compatibility with other drugs. Drugs, food additives and vitamins may be prescribed only by a specialist who follows up an athlete, is knowledgeable in a particular sport and involved, together with the coach, in planning the training process.

We disagree with some of concepts which are seen in the literature on pharmacology of sport. The concepts imply that pharmacology alone improves the performance and that sports pharmacology is the pharmacology of a healthy individual. Athletic performance cannot be improved by drugs alone, as it is a result of hard work which, with assistance from clinical medicine and science, cannot induce health abnormalities. Permanent readjustment of effort makes it an optimal work, and this is where pharmacology is helpful in control of fatigue and in rehabilitation complete with efficient immunomodula-

tion. There are no miracles... There are drugs which help achieve the sporting result, but the result has to stem from something (it is a matter of availability of the something). The result should be a product of cleverly arranged training, and choice of drugs, and their dosage should be adjusted to an individual organism. It is no good when a group of athletes is doing the same training task and getting the same pharmacologic support (unlike physiotherapy). Such work is not very rewarding, even though short-lived improvement of results may be seen, explainable by accelerate effect (biologic growth of the organism) or by a "lucky strike" of the athlete's talent. However, this is not a level he or she could have achieved.

As for pharmacology of a healthy individual, it is nonexistent, in sport too. This is related to the level of world achievement and unprecedented strain which sometimes is close to the limit of possibilities of the human as a species. Extra class results, which are sought in training, are not conceivable without regular and full medical control of the organism state which widely varies with individual, genotypic features and which often is on the brink of disease. This is when efficient pharmacological support with its full arsenal of drugs, certainly minus banned ones, is recruited from clinical practice where they are used for treatment of severe diseases. And this is normal in the struggle for health of athletes, who, other considerations apart, need legal protection against bungler specialists.

The goals of medical support of sport are, first, not to harm and, second, to help. The help should be based on a regular update of knowledge of athletes' organism through fundamental research and an understanding of specific tasks rather than on the use of various drugs "to crack a nut with a sledge-hammer". By biomedical support of the training process, specialists must help athletes cope with the planned intensity of workloads without loss of speed, strength or body weight and keep

them in a proper psychophysiological condition (14).

At these times of rapid progress in different scientific disciplines and technologies, enormous numbers of drugs, stimulators and food additives are designed, manufactured and spread commercially. This should be met with caution and understanding. Advertisement may not give a real picture of a product. However, much positive is happening too: designed biotechnologic drugs and gene engineering products offer maximum biologic, therapeutic, rehabilitating and other effects. Efficient pharmacologic support of top achievement sport is no simple task. It requires knowledge of not only pharmacokinetics but of the flux of processes in an individual organism, of mechanisms of various abnormalities at an intimate level if the onset of persistent clinical symptoms and syndromes is to be averted (16, 17).



### 1.1.7. Psychophysiology

Very often athletes of ample talent put in huge effort and show all but world record results during the training, only to do a lacklustre job in contest. All specialists who long work with top qualification athletes have encountered this. Some of numerous explanations are methodologic errors in the training routine or in the pre-contest period. However, there is the need for a closer look at the psychophysiology of achievement.

Coaches have their own phrase for the less-than-expected performance: an athlete "leaked", "needed pampers", "went out water-kneed", etc. ***Much calls are heard, sceptical from hopelessness of the situation, about the "need for the presence of a psychologist"; some of them recall known athletes in need of help, who, at times romantic for steroids, took them "by ton", unknowingly heading for real and tough consequences*** (16, 17, 18).

In our view, things are not hopeless. With progress in fundamental research, computer and gene engineering technologies, modern science has got an adequate arsenal of interventions for such stress-induced condi-

tions. By using new or old forgotten methods specialists in biomedical support of training can significantly improve the psychophysiological condition of their charges, relying on objective test data and current understanding of mechanisms of psychoemotional tension at the cellular level and using pharmacological and physiotherapeutic support just in time.

Abnormal levels of neuromediators, or stress-mediating substances, detected by biochemical blood or urinary tests are not always associated with the onset of systemic symptoms. Genotypic stability of the vascular response and functional individuality of microcirculation or peripheral circulation may protect an athlete from hypoxia or hypertension which affect performance in contest. Nevertheless, the thesis that **functional disorders are secondary and have their roots at the cellular level** certainly has its role. Something always happens for the first time; indeed, compensatory potential of the body is not infinite, and then the situation occurs where an athlete affected by stress (fear) goes to the start with his functional possibilities drained as if he has gone through half of the sport event. Is a top result possible?

Therefore, regular examinations of athletes during the sport season should be complete with psychophysiological tests. These may be conventional or modified versions of Minnesota or Spielberger scales combined with the galvanic skin test and galvanic skin conduction, beat-to-beat variability which describes functional potential and vegetative homeostasis, or a set of stimuli mimicking the prestart situation. The practice shows that along with biochemical and hematologic tests, these methods are often helpful in revealing initial symptoms and averting conditions that affect performance. Sometimes efficient care can reverse already existing problems.

### **1.1.8. Genetics**

Russia is among developing countries where genetics of sport is concerned (45), said the 1st Moscow International Conference on Sport Medical Science and Practice on the Threshold of the 21st Century. This is fair, even though developments in this area have not found systematic use elsewhere in the world either. Progress in this field is so far limited to fundamental research and practical use of a few promising discoveries. However, pioneering steps in this direction should not lead to over-enthusiastic conclusions about findings like a number of nucleotides mapped to one gene. Any human activity is versatile and to evaluate its prospect, the spectrum of identification of new genes should be expanded. An important line of progress in molecular genetics for sport is the development of DNA diagnosis and DNA technologies. We think the practical value of this research will be apparent soon.

### **1.1.9. Physiotherapy**

As athletes are systematically and fully examined at different phases of training, specialists use objective diagnostic data to recommend heart rate regimes of strain and give athletes qualified assistance for optimization of fatigue and recovery with the help of drugs and physiotherapeutic procedures. The most common physiotherapeutic methods used in practice are electrostimulation, ultrasound, balneotherapy, hydrotherapy, massage, phototherapy, etc. These time-honoured treatments are successfully used in rehabilitation of athletes. However, these procedures are rarely supervised by specialists.

Let us take sauna as a simple example. The procedure is useful, as it eliminates metabolites and degradation products which are produced by training and which are located peripherally, where millions of collapsed capillaries are available (persistent peripheral spasticity is a precursor of hypertension). Within training microcycles, one day is chosen, usually after intensive work on the previous day or in the morning of the current day, for this enjoyable procedure. However, there are no guides, except for the athlete's well-being, for the number of

exposures to heat during one visit to sauna or their intensity. And the blow to the organism sometimes proves so hard as to leave an athlete in need of rehabilitation from the sauna "rehabilitation" rather than from training fatigue. In our observations, a maximum biologic effect of sauna occurs three times during a microcycle of intensive training: after entering sauna one-two times for stay until initial sweating and immediately after a second practice. Careful individualization is also needed for other physiotherapeutic procedures (various types of massage, including diagnostic one), the principles and purpose of which have been extensively reported.

### **1.1.10. Quantum medicine**

Quantum medicine is based on the use of low doses of the electromagnetic field and laser radiation for treatment, diagnosis and prevention of various abnormalities. It uses electromagnetic factors, similar to those occurring in nature, which have beneficial effects on cells, organs, systems and the entire organism. Low energies used in quantum medicine are absolutely safe. This section of the book addresses mechanisms and principles of optimal dosage, and applications of quantum medicine in top achievement sport.

### **1.1.11. Ultrasound diagnosis**

Ultrasound diagnosis is an important part of biomedical support of training and associated research. Ultrasound adds to the arsenal of specialists the possibility of obtaining information about internal organs, their homogeneity, the presence of hypertrophic changes, the condition of heart valves and the myocardial tissue in different periods of training.

### **1.1.12. Computer technologies**

Computer technologies allow adapting current diagnostic methods and programs to available evidence for designing diagnostic protocols with which to evaluate the condition of athletes at different phases of training. Biomedical specialists can cooperate with designers in programs and methodologies combining known and original diagnostic tests, with simulation of various adverse factors like contest anxiety. The test systems can be used in conditions of training. Room for improvement and modification of methodologies in this area is very large.



### 1.1.13. Experimental medicine

Biomedical support of top achievement sport cooperates with different areas of experimental medicine, orienting researchers toward solving specific tasks in a given sport and in different periods of training. For example, biochemical tests of small samples of peripheral blood obtained during the start is crucial for understanding individual features of an athlete and improving his or her potential by different corrective interventions or for further improvement of the potential of telemetric systems in evaluation of several parameters during intensive training for its necessary readjustment and getting a maximum biological effects at each training practice.

It is necessary to exclude inappropriate "scholarship" seeking to create new tests of an abstract state of the athlete's non-specific fitness. Who can assess it better than the trainer and the stopwatch? ***Any trainer can tell what result his athlete can expect at this particular time, and he will not be in error.*** Both need real help in tapping new possibilities of training, enhancing its biologic effects, controlling fatigue and hastening recov-

ery after hard training. The help in improving performance which in turn results in a new qualitative state of the organism. Top achievement sport is a very complex challenge which dictates an individual rationale and daily solving of tasks. And, certainly, the real practical help in making a maximum use of done work aims at an extra class result.

#### 1.1.14. Institution of consultants in various disciplines

When we hear specialists say that they know all about a sport or an athlete, interest in further contacts dies. Such a notion precludes progress. Therefore, finishing the sections on ***diagnosis, which we see as a key to a new concept of individualized training***, we decided to mention the need for relying on expertise of top-qualification specialists in different areas of medicine as consultants who give athletes a real help in avoiding injuries and retaining health.

Certainly, specialists who are regularly involved in biomedical support of training cannot simultaneously attend to gynecological, urological, dental and other conditions. However, seeing symptoms and complaints, they can refer athletes to relevant specialists.

Metabolic, endocrine or neurologic signs and symptoms, obscure ultrasound or immune test findings warrant team discussion and decision-making ***for the sake of the athlete's health, a key component of success***.

**1.2. Immunomodulation:  
Immunodeficiency is an attribute of  
intensive training**

Experience shows that an enormous loss of the training ability in top achievement sport occurs because of immunodeficiency (12). Specialists know presentations of immune impairment well, and the pathogenesis of it has been reported in detail. It is doubtless that intensity and regimens of uncontrolled strain by which immune system reserves are depleted vary with athletes, depend on numerous factors and relate to the genotype. Utmost physical and emotional strain often causes functional immunodeficiency.

The need for systematic immunological control of the athlete is doubtless. It should be stated that intercurrent conditions which contribute to immune impairment (allergy, acute respiratory viral infections, chronic infections, dysbacteriosis, training in mountain terrain, time zone maladaptation) are easy to identify with the diagnostic tests described by us in earlier sections and to treat.

Conventional biochemical, hematological and immunological tests have been used in our long-term studies during follow-up examinations and immune evaluation of athletes. Over the recent years, we have added to

these studies a simple, readily reproducible test for evaluation of the skin autoflora (Klemparskaya, Ivanov) (28, 29).

It is known that skin microbial counts of normal individuals are stable and reflective of antimicrobial resistance and the immune status. ***The counts are increased by endogenous and exogenous factors and, as has been shown by us (12), by physical strain.*** This change usually occurs before the onset of clinical symptoms, of which it is a precursor. Long-term studies at the Russian Institute of Biophysics, at which the author of this book worked for about 20 years, the Russian Institute of Immunology and the Harvard University have demonstrated a correlation between microbial strains and counts and the state of antimicrobial resistance.

The principle of the skin autoflora test (SAFT) proposed by us is as follows: skin microbial counts increase with declining antimicrobial resistance. The skin autoflora is sampled from the internal (palmar) surface of the right forearm. The surface of a nutrient medium contained in a plastic box is slightly pressed to the skin. The box is sealed by the lid and incubated in a thermostat at 37 degrees Centigrade for 24 hours, after which microbial colonies are counted. Obtained counts are categorized into:

- normal - up to 20 colonies,
- increased - 21 to 100 colonies,
- high - over 100 colonies,
- very high - solid growth of colonies.

Individuals with over 100 colonies are at a risk of disease or are in a prodrome. The predictive value of the test is very high. Patterns of SAFT findings in apparently healthy individuals and athletes in various sports tested in inter-contest or rest periods are presented in Fig. 1.

Antimicrobial resistance depression in groups is expressed as percentages. The figure shows that normal counts (up to 20 colonies) were found in 75 percent of normal individuals, while they made 32 percent in ath-

letes, an alarming value to say the least. Increased colony growth rates in the groups were respectively 10 and 28 percent. At risk groups with counts of over 100 colonies or solid growth made proportions of 15 percent of normal subjects and **40 percent of athletes who were immunodeficient even during the rest period**. The cause of this distressing finding is not a mystery for specialists.

In our many-year studies, adaptogens, immunomodulators, which stimulate interferon production, enzymes, which inhibit immunoglobulin binding to blood cells, and antioxidants (beta-carotene as an endocrine stimulator) were used. An addition, at the start of the training season athletes were given as a bionormalizer, a preparation from the human placenta which did not contain protein and hormones (10, 12, 13). This product (Bioglobin) was obtained by a new technology of placenta treatment with dioxide chloride; subsequent separation of heavy fractions and special filtration techniques yielded a high-purification solution which is by far superior to placental extractions or suspensions and to Amniocen (30).

***Bioglobin is a mixture of water-soluble peptides from the human placenta with oxidized amino acids in their composition. The water-soluble extract contains a range of trace elements but no protein and hormones, and has no antigenic or allergic properties. Its overdosage and prolonged intake produce no toxic effects.*** As a bionormalizer, Bioglobin has a prominent regulatory and corrective effects on metabolism, analgesic and antiinflammatory properties. Using it as a metabolic bionormalizer with strong reparative and antistress effects, we found out its prominent immunostimulating action which was seen as improvement of cell-mediated immunity and return of circulating immune complex levels to normal (14).

The advent of new gene engineering and biotechnological agents like leukinferon, a chemically sterilized and purified product, or human interferon and other

cytokines from blood of normal donors has expanded the range of promising immunomodulators. Available studies and the evidence presented below qualify these derivatives as biotechnology products.

Figure 2 presents results of our long-term comparative studies which used the skin autoflora test to delineate at-risk groups among apparently healthy individuals and athletes at different stages of training (basic, special, pre-contest training) and in the contest period. The left part of the figure shows that with the start of training, SAFT counts grew incrementally in athletes who had not been given immunomodulation treatment. However, it can be seen from the figure that the use of Bioglobin and other biotechnology products was associated with a decrease in SAFT counts in at risk athletes to normal values (the effect of Bioglobin was somewhat delayed only during the basic training). An immunomodulation regimen averted common colds and reversed immunodeficiency induced by hard training. The immune status of athletes was controlled by SAFT and was part of systematic evaluation. The immunomodulation regimen was repeated whenever necessary. This methodology was awarded a prize at the international show Sports Industry '2000.

The use of these methods in multimodality correction of homeostasis during the training process allowed athletes to efficiently cope with strain and substantially improve their results.

Within a short time, athletes from different countries who were under our surveillance have set over 20 records in world and European championships and over 60 national records.

### 1.3. Designing an individual training methodology: Control of strain is prevention of disease

The amount of training work, the highest result in a previous season, full information about health of an athlete and realistic expectations of the result in an upcoming contest help form an individual training program.

Each training period has specific goals and objectives with account for the general amount, intensity and purpose of training effort which are after all determined by the condition of the athlete's organism.

It should be stated that the trainer has a key role in the individualization process. Education, intelligence, experience, healthy ambition, willingness to improve professional qualities and motivation enable the trainer to make a good use of the knowledge of the athlete's condition. A sparing attitude to health of athletes in charge of the trainer is last but not least.

***Thoughtless pursuit of programs borrowed from successful predecessors, which trace back to the romantic past of steroids or other drugs and which destroy athletes, fear to learn and show incompetence, with the barrage "we'll see how it works out", are bad aides in forming an individual approach to training.***



The situation as it is in big sport makes one take a sober look at the available training know-how. After all, the coach who works with the athlete and who is responsible for improving his performance should come, for the athlete's sake, to an individual concept of modern training and to his or her vision of developments in the sport world.

It should be noted that there have been significant changes in activities of the International Olympic Committee: the list of banned drugs has been extended, a new body, WADA, has been set up with representation of the Council of Europe's sport department, UNESCO and sport ministers of different countries. Participation of all countries in national programs of the dope testing of athletes, all-year-round international control, the funding of research on tests for trace amounts of banned drugs (31) demonstrate a new level of control of doping and a real prospect of its eradication.

Therefore, ***biomedical support of top achievement sport is leaving its traditional boundaries of sports medicine and taking its place in the complex process of preparing a sport elite, seeing it from the perspective of health of athletes, with the motto "Toward Top Achievement and Longevity in Sport Without Doping".***

The trainer forming a concept of conditioning the athlete from the perspective of biomedical support of the training process should take account of three circumstances:

(A) ***Secondary nature of functional changes induced by strain.*** The trainer visually assesses the condition of his or her charges - their physical appearance, mood, complexion, pulse and quality of performance. However, precursors of excessive fatigue or abnormalities are changes at a subtler level. They can be identified by a specialist who uses special devices and knowledge. Their early identification and correction sometimes prevent very prolonged loss of the training ability.

(B) ***There are no prescriptions.*** Each athlete has a vivid individuality. This concerns exterior, phenotypic features and individual peculiarities of bone marrow, cardiovascular, endocrine or metabolic function. A specialist who systematically observes an athlete and is involved in forming the training process should have detailed individual information about the athlete. Only teamwork and joint creativity can lead to success expressed in seconds, kilograms, body coordination, etc.

(C) ***There are no miracles.*** Hope for a windfall result or help of a miracle is not bad in itself. The human should believe in and hope for a miracle - this gives him energy for the search. However, ***the sought miracle can happen only when it is realistically predicted, calculated and prepared by daily painstaking work in pursuit of the chosen direction.***

Let us briefly consider the role of biomedical support of top achievement sport in designing the individual training methodology using Chart 1 presented earlier in this book. This section reviews mostly medical support of moderately intensive effort of the basic training and the utmost hard strain of special training. In fact, these are periods of the organism's preparation for obtaining and consolidating a new quality.

### **1.3.1. Basic training period**

This period should go with adequate immunomodulation and regular pharmacologic and physiotherapeutic correction of the condition of the athlete's organism. The athlete is thoroughly and systematically evaluated using diagnostic methods presented above. Obtained information, which depicts individual features of the organism, allows correct adjustment of strength, flexibility and endurance exercise.

Forming a new quality of the blood supply of striated muscle (vascularization and capillarization processes) and energy supply of muscle through active and optimal training activity of visceral organs during exercise allows the athlete to fulfil without losses individual tasks of cultivating necessary exterior qualities, such as lean mass or striated muscle. Systematic and full examination of athletes provides follow-up estimates of some or other internal qualities required by the organism. This information enables the trainer to make timely decisions on a specific training cycle by daily readjustment of strain, sometimes departing from plan. Efficient pharmacologic and physiotherapeutic support prevents losses in this period. Drugs which are

used by specialists in charge of the athlete reflect their knowledge and qualification.

It should be remembered that the athlete's condition significantly improves outwardly when the basic-period training regimen is correctly designed. The athlete may show high results during this period, but euphoria over initial success should be avoided, and the training should not be rushed along. This is not a new quality but the use of potential which the organism had built during the previous season and improvement of performance. Again, evidence of systematic biomedical studies helps objectively assess this condition and avoid wrong decisions. It should be also remembered that ***the training process is aimed not only at gaining new external qualities***. The most important processes occur at more intimate organic, tissue, cellular and intracellular levels. If the role of disorders seen at a cellular level is understood, one can prevent organic and systemic-level abnormalities which in a longer term can lead to functional abnormalities and eventual loss of qualities acquired in hard work.

***The training process is aimed first of all at obtaining a new functional quality of visceral organs and systems (cardiovascular, respiratory, endocrine, hemopoietic, etc.). The new quality of function in turn leads to adequate formation of the external aspect of training which is sometimes wrongly taken for an absolute value. Awareness of this leads to systematic success, and not lifelong reaping of laurels of luck which once fell to an athlete in the form of talent.***

Individually adjusted exercise in other sports during the basic training is a prerequisite for adequate preparation. The mandatory aerobic exercise is running, skiing, strength training in the gym with elements of speed, endurance and flexibility drilling. Accents in this work are decided by the trainer with regard for objective evidence of the athlete's condition. Real pharmacologic and physiotherapeutic support in this period significantly improves rehabilitation processes and prepares the organism for the exhausting strain of special training.

### 1.3.2. Special training period

Biomedical support in this crucial period of training is very important. Diagnostic errors, failure to readjust strain intensity and inadequate supporting therapy can cost dearly. Like in the basic training period, regular evaluation of the immune status and, when appropriate, a repeat immunomodulation regimen are important here. The pattern of pharmacologic and physiotherapeutic individualized correction of homeostasis in this period is determined by the athlete's condition and by the time schedule of tasks he or she is to meet, and these should be recommended to the trainer by a specialist relying on medical test findings.

***Exactly in this period, it is especially important to optimize recovery processes which prevent overstrain and the onset of abnormalities without impairment of speed and strength qualities and loss of body weight!***

Therefore, it is quite important to examine an athlete during the hard, exhausting training, when external signs, the mental state and the heart rate may not provide any guides in assessing the biologic effects of work.

Very often there is the need for having the athlete repeat a task to get a glimpse of his or her condition.

***Getting a maximum biologic effect of each special practice*** without trespassing the borderline between health and disease, balancing fatigue and recovery ***are a main way to gaining the new quality.*** Such training should be prepared with reliance on biochemical, hematologic, cardiologic and other pictures of recovery and on psychophysiological assessment of the athlete's readiness for physically and emotionally exacting tasks.

The range of diagnostic criteria selected by a specialist for evaluating the individual pattern of the athlete's response to strain and the rate of recovery plays a special role. We think criteria like lactate production are no longer of interest, as the lactate response has five genotypically determined types.

***The key tasks of a specialist providing medical support of training are not to harm and to help*** (see previous sections). Harm can be done by misinterpreting the recovery process and overlooking excessive strain or impending abnormalities in this period. The resultant need for prolonged therapeutic rehabilitation can undo the whole preceding work. An accurate diagnosis is very important; if changes occurring in the body are misunderstood, adequate pharmacologic and physiotherapeutic support is impossible. Therefore, a specialist must have a full range of diagnostic facilities even in conditions of camp training.

***The time of individual decision-making is going for good together with romanticism of dreamy waiting for pharmacologic miracles. Only an understanding of processes occurring in the organism allows assessment of miracles of adequate work and efficient pharmacologic and physiotherapeutic correction of the athlete's homeostasis.***

#### **1.4. Achieving the result**

Achieving sporting results is an interesting phase which finishes the training process. Adequate work and good health of the athlete allow an optimistic view of pre-contest training which has its stages, goals, general and special know-how.

### 1.4.1. Precontest training

Any manual or textbook on sports pharmacology in Russia or abroad has special sections with lists and dosages of drugs recommended for use in a precontest period. **However, no textbook can give a realistic description of the athlete's individual state** in the so-called narrowing period, a gradual transition from special work to precontest preparation.

Only systematic medical support continuing into this period provides a full picture of this transition and helps the trainer plan and readjust acute glycolytic and creatine phosphate workloads which are of strategic importance. When excessive, such workloads can provoke serious changes in biochemical and hematologic homeostasis and affect the performance in contest. The excesses often damage the athlete's preparation: **uncertainty of the trainer very often pushes him into multiple repetition of meaningless testing tasks with a maximum heart rate.**

Only full knowledge of the organism at the most subtle levels of its response can make the work tactically judicious at this strategically important time. Efficient indi-



vidual pharmacologic and physiotherapeutic support complete with relief of precontest emotional tension represents ***a special teaching and formative algorithm***. And medical support relying on objective knowledge is very important in creating the optimal individualized algorithm in the precontest period. Real help to the trainer and the athlete in this period is an integral part of biomedical support of top achievement sport.

### **1.4.2. Contest period**

An athlete who has been through individually optimized, adequate preparation comes to the contest emotionally high and with a tremendous poise to compete. Biomedical support in this period also has its features. It should recruit an arsenal of state-of-art means and methods of individual assistance to athletes. This process has general tacks which formed for years or in the training period and special approaches which may need a rapid readjustment.

As we have stated above, there are no prescriptions, as individual features of top-level athletes vary in a very broad range. Therefore, any preparation in any period, including contest-close, is a creative process which always differs from similar former events and which relies on knowledge of a concrete organism obtained in the process of medical support.

## 1.5. Return of the organism to rest. Preseason preparation

***The concept of methodologic support of the modern training processs should view achievement of results from the perspective of the athlete's health.***

Efficient biomedical support in all periods of training has a main role in it, and one of its major goals is longevity of athletes in sport. To get at least a tentative answer to the question about benefit of top achievement sport for health, there should be a clear understanding of the following considerations:

(a) a person who made sport a pursuit of his life must never stop exercise, even after his or her career is over;

(b) a specialist involved in medical support of training must observe the athlete in the daily life, recommending the amount and intensity of supporting exercise. This principle should be used in interseason and rest periods. Regular aerobic supporting exercise (for enjoyment) should be used as a stabilizer of the athlete's condition in the rest period. This also allows an easy return to basic-period training next season.

Therefore, efficient biomedical support of the train-

ing process

- averts abnormal conditions induced by overstrain and a lack of adequate rehabilitation;
- rules out the use of banned drugs;
- excludes an intuitive approach to the training process;
- enhances biologic effects of each practice;
- improves the task performance;
- prevents stagnant results;
- helps longevity in sport and life.

## Summary

We have presented in section I conceptual considerations of biomedical support of top achievement sport and the modern training process. On the one hand, we wanted to lay out to readers the main possibilities which can be broadly used in athlete preparation. On the other hand, we did not set out to lecture to specialists (trainers, doctors, biologists). We thought it important to let all involved in top achievement sport to think and decide for themselves which road into the new millennium to take.

## **2. QUANTUM MEDICINE OF TOP ACHIEVEMENT SPORT**

The key goal of biomedical support of top achievement sport is real assistance to the trainer and the athlete on their thorny way to result. The task is to form the individual training process with careful readjustment of strain and correction of the athlete's homeostasis through systematic and revealing diagnostic evaluation of athletes using a broad range of tests, criteria and individual, genotype-specific algorithms. And thereby to optimize fatigue and rehabilitation processes. Part of biomedical support is the development of a new approach to immunomodulation, pharmacologic and physiotherapeutic correction of function of a shock organ (a most vulnerable organ during hard training) through creating individual algorithms of precontest training.

Methods of quantum medicine are logically and effectively used actually in all areas of biomedical support of the training process. Quantum medicine is one of the most promising and rapidly developing areas at the junction of medicine, quantum physics and high information technologies. It is a combination of knowledge and

methodologies which make use of electromagnetic radiation, quantum processes, wave and information properties of live matter. It is apparent by now that quantum treatment is an effective means for homeostasis correction.

Our initial experience with quantum medical methods has yielded unexpectedly lasting beneficial effects which were seen as improvement of several biochemical parameters in athletes after the use of magnetic-infrared laser radiation as physiotherapy during rehabilitation after hard training. Long-term studies and the use of quantum methodologies in biomedical support of top achievement sport have led us to a clear concept of their applications at different phases of training. This section addresses principles of dosage, timing and location of magnetic-infrared laser treatment during the training and precontest preparation. We hope that our experience will prove helpful in preparation of extra class athletes.

## 2.1. An introduction to quantum medicine. Major modes of multifactorial quantum therapy

Let us return to the definition which we have slightly modified to add to it conceptual substance.

***Quantum medicine is a combination of knowledge, means and methods based on the use of electromagnetic radiation, quantum processes, wave and information properties of live matter for effective correction of homeostasis of the organism (our definition).*** Quantum medicine relies on low doses of electromagnetic radiation (quanta). It employs natural factors which are similar to environmental ones and low energies which are absolutely safe for human health (32, 33).

Biologic effects of quantum therapy seen at the systemic level are related to its ability to influence more intimate structures, including cells and cell-to-cell contacts. The effects are related to tissue and organ levels (according to the notion that functional changes have a secondary role in the disease onset). Elucidated mechanisms of the effects will be presented below. Radiations with the most potent therapeutic effects are the magnetic field; infrared and extremely high-frequency radiation; red and green light (34).



Let us briefly review these modalities.

- 1) The magnetic field contributes to energy protection of the body against adverse environmental factors. It has analgesic, resorptive, and antiedematous effects, and improves tissue nutrition.
- 2) Pulsed infrared laser radiation has a 10-13 cm penetration and strong stimulating effects on blood circulation, neurohumoral and hormonal factors. It has regenerative, antiinflammatory, analgesic and immunostimulating effects with activation of protein and enzyme synthesis and of capillary circulation.
- 3) Continuous incoherent infrared radiation has a lower penetrating ability as compared to laser light. It has beneficial effects on the central and vegetative nervous systems.
- 4) Pulsed red light penetrates shallow depths and exerts significant antiinflammatory, analgesic and antiedematous effects.
- 5) Pulsed green light has tonic effects on the gastrointestinal tract and a stress-relieving action. A maximum therapeutic effect of these factors is achievable by their combined use.
- 6) Effects of extremely high frequency radiation are specific. Its biologic efficacy is highest when it is used as a reflex therapy. This type of radiation is not discussed in this book.

## **2.2. Equipment**

The pioneer and key designer in Russia's quantum medicine is the Quantum Medicine Association. It is based at the worldwide-known Special Designer Bureau, a space engineering company, and at present is a main manufacturer of quantum therapeutic and diagnostic equipment. Figure 3 presents quantum medical devices designed and manufactured by the Association. We used this equipment to form our multicomponent hardware complex which is recommended for biomedical support of top achievement sport.

### **2.3. Some biochemical mechanisms of low-energy laser radiation: The role of plasma membranes as targets of quantum treatment**

The universal effectiveness of any therapeutic means with a spectrum of biological effects seen at different levels is usually determined by a direct or a strong mediated action on a major pathogenetic mechanism (and not a variety of individual responses).

Elucidating the nature of an endogenous target of a treatment is essential for an understanding of mechanisms underlying its phenomenology and for expanding the spectrum of its beneficial effects. A lack of knowledge of the mechanism and nature of a major target makes the treatment difficult, and leaves more leeway for intuitive use of it. However, even in this case an optimal choice of intensity of the treatment is possible for maximizing its therapeutic efficacy (a consideration which will be discussed in a relevant section).

The clinical efficacy of magnetic-infrared laser therapy has been confirmed by numerous publications which reported its prominent antiinflammatory, analgesic, immunomodulating, antiedematous and other effects observable at the systemic level (32, 34, 36). Numerous studies which sought explanations for benefi-

cial effect of this therapy from the perspective of molecular and cellular mechanisms have yielded many hypotheses which usually rest on the finding of an endogenous chromatophore for low-energy laser radiation. The most comprehensive analysis of available theories and evidence on molecular and cellular mechanisms of laser therapy have been presented in works by G.I.Klebanov (33, 35, 37).

The following molecular structures have been cited in biophysical studies as endogenous chromatophores: porphyrins and their derivatives, enzyme molecules, molecular oxygen and components of the mitochondrial respiratory chain, such as flavoproteins and cytochromes, or components of the electron transport chain, tetrahydrobiopterin, ionized calcium-mediated processes resulting in cell priming, biopolymers, antioxidant enzymes, etc. Interpretation of effects of laser therapy is most acceptable for specialists in biomedical support of top achievement sport from the perspective of biochemistry, hematology, immunology or other disciplines on which they rely in clinical decision-making during regular correction of borderline changes induced by hard training using drugs which are allowed in sport with control of their kinetics and biochemical levels.

What biochemical changes precede and facilitate beneficial effects of laser therapy on the human body during combined (synergistic) use of several types of variable magnetic fields of different spectra and of the static magnetic field?

Laser light is known to influence major steps of a common pathogenetic mechanism, such as lipid peroxidation, whose activation can be considered as a universal mechanism of plasma membrane damage. Exposure to laser light is associated with a decrease in malonic dialdehyde concentrations (a lower lipid peroxidation rate) and activation of antioxidant enzymes (superoxide dismutase, catalase, ceruloplasmin, glutathione peroxidase), intensification of cellular metabolism and stabi-

lization of biomembranes. It is also known that a prerequisite for stable therapeutic effect is normalization of the activity of superoxide dismutase, ceruloplasmin, porphyrins and their enzyme derivatives which are in contact with plasma membranes of cells. Through lipid peroxidation, porphyrins have an ionized calcium-mediated effect on the endothelium derived relaxing factor which softens vascular walls, with resultant improvement of microcirculation which is made stable by enhancement of cytokine production during leukocyte priming (37). Signal substances, cytokines, have a significant role in generalization of therapeutic effects of the low-energy laser regardless of their location. Cytokines, which are in the circulating cell pool, contribute through plasma membranes to the combined response of organs and systems, a process supported by copper-containing redox enzymes - peroxide radicals and catalase which remain on the cell surface in an unbound state (38).

Our *in vivo* model studies using an erythrocyte sedimentation technique of Potemkin et al. (8, 9) have examined effects of different dosages of laser radiation on various components of plasma membranes. The protein component of biomembranes was found to mediate a dose-dependent effect. The studies will be continued soon. Our earlier hypothesis of a major role of plasma membranes as a target of magnetic-infrared laser therapy (10) has been corroborated by numerous reports. This evidence also demonstrates that biomembranes mediate beneficial effects of quantum therapy at the tissue level. Thus effects of low-energy laser radiation on erythrocyte membrane deformability facilitate the entry of erythrocytes into capillaries. Stimulation of aerobic metabolism involving underoxidized glycolysis metabolites and lipid peroxidation products results in venous blood oxygen saturation through a membrane mechanism and in microcirculation improvement through a single mechanism mediated by ionized calcium (and not selective calcium channels or kallikrein-kinin system

activation which depresses the production of vasoactive peptides, kinins).

Postquantum effects cause change in the physico-chemical state of cell membranes to increase the functional and enzyme activity of blood cells. The effects activate, through beta-adrenoreceptors, cAMP release into circulation, and enhance enzyme reactions (39) and protein (RNA, DNA), ATP and prostaglandin synthesis. Other postquantum effects are depression of the lipid peroxidation rate with a resultant boost to antioxidant processes and collagen synthesis. Our earlier studies (10) have demonstrated a postquantum increase in cell membrane permeability to Bioglobulin, a water-saline product of the human placenta. The cell membranes also show a higher resistance to lipid peroxidation products due to superoxide dismutase activation and improved stability of the enzyme complex which mediates oxidative phosphorylation involving the above mentioned steps of microcirculatory improvement and triggering a multifactorial cascade mechanism of bionormalization of metabolism.

This is an incomplete range of crucial membrane-mediated effects of quantum therapy which are suggested even by a tentative analysis.

***Long experience with quantum medical methodologies in biomedical support of top achievement sport in combination with drug correction of homeostasis at different phases of intensive training and emotional strain of contest has shown that low-energy laser radiation has antioxidant, immunomodulating, regenerative, stimulating and drug-potentiating effects. Low-energy laser treatment improves peripheral circulation and nutrition of striated and smooth muscle, and has beneficial effects on the psychophysiological state. The membrane-mediated action of laser therapy originates at the subtle biochemical level and transforms into the tissue, organic and systemic response presenting as a substantial therapeutic effect.***

## **2.4. Quantum medicine of biomedical support of training**

Quantum medicine is a logical component of modern biomedical support of top achievement sport at all stages of athlete preparation. Comprehensive and systemic evaluation of athletes using a range of easily reproducible methodologies (including biochemical, hematology, ECG, ultrasound and other tests) allows timely and effective correction of homeostasis of athletes' organism for adequate formation of fatigue processes which do not become disease and for hastening the rehabilitation. This approach provides specialists with permanent and full information about the state of the organism and allows them to use multipurpose effects of low-energy laser radiation which are close to harmless natural factors of electromagnetic treatment for improving the performance of athletes (1, 2, 3, 11).

The equipment described in the previous section combines four therapeutic factors: narrow-band and broad-band laser radiation, invisible infrared light and the static magnetic field. Dosage of combined magnetic-infrared laser treatment is determined by reference values for each operation regimen of an emitter (38, 40).

The powerful antioxidant, immunostimulating, regenerative, stimulating and drug-potentiating effects, improvement of peripheral circulation and nutrition of striated and smooth muscle, a beneficial effect on the psychophysiological state and performance can be achieved by contact magnetic-infrared laser treatment during which the emitter is placed on a body site. The broad range of possibilities of low-energy laser radiation is presented in flow chart 2 (Potemkin) which describes applications of quantum medicine in biomedical support of top achievement sport.

One of goals of this book is to introduce physicians, biologists, trainers, pedagogues and athletes, who make a team in training individualization, to quantum medicine and to assist them in systematic use of beneficial effects of low-energy laser radiation during the training and contest period. Chart 2 illustrates possible uses of quantum medical methodologies in top achievement sport.



### **2.4.1. Quantum correction of homeostasis during the training process**

With an extra class result and health of an athlete as goals, specialists are tasked with efficient correction of homeostasis and averting progression of negative changes to abnormalities. Regular use of contact low-energy laser radiation, along with other interventions, is an inalienable part of this process. Magnetic-infrared laser treatment can be viewed as a tool for homeostasis correction.

#### **2.4.2. Immunomodulation and quantum medicine**

Immunomodulation is an important component of athlete training. Approaches to immunomodulation and methods of its control and optimization are presented in section 1.2. The role of quantum medical methodologies in immunomodulation is very important. Our above cited studies have demonstrated a remarkable aftereffect of the low-energy laser presenting as an increase in bio-membrane resistance to lipid peroxidation products because of superoxide dismutase activation and improved stability of enzymes which mediate oxidative phosphorylation, with stimulation of microcirculation. This effect was related to a sustainable response to immunomodulators during magnetic-infrared laser treatment which makes cell membranes more permeable to drugs (10). The ability of low-energy laser light to prolong and potentiate effects of drugs has been extensively reviewed in the literature (41, 42).

A recommendable method of periodical immunomodulation in athletes is a ten-day regimen of immunotropic drugs in combination with magnetic-infrared laser treatment. This regimen should be controlled by the skin aut-

oflora test (section 1.2) and biochemical, hematologic, immunologic and other tests used in biomedical support of the training process. An optimal dosage of lower-energy laser treatment during the immunomodulation regimen is presented in Table 1.

Table 1

Optimal dosage of low-energy laser radiation during the immunomodulation regimen

Treatment projection	Frequency (Hz)	Time (min)	Number of procedures per day	Course (days)
1. Cubital fossa	50	2	2 (morning/ evening)	10
2. Apex beat	50	2	2 (morning/ vening)	10

Total dosage per course: 1,280 mJ.

**2.4.3. Quantum medicine and training individualization: Optimization of fatigue and recovery**

The concept of biomedical support of the training process and its individualization has been reviewed in the previous sections. It is obvious that quantum medical techniques are essential in homeostasis correction. Designing an individual low-energy laser dosage for each athlete is part of the training methodology which is a cluster of a great number of components. Principles of systematic use and dosage of magnetic-infrared laser treatment relate to goals of a particular training period.

## 2.5. Basic training period

The basic training period is associated with low-intensity exercise, mostly in an open-air setting, which is aimed at getting a new quality of blood and energy supply of muscle and an optimum training activity of internal organs. This period requires immunomodulation using quantum medical techniques, regular correction of homeostasis, pharmacologic and physiotherapeutic support. This phase is a preparation for maximum strain of special work. A low-energy laser regimen which has been started during the course of immunomodulation should be continued in this period for improving the quality of pharmacologic support and stimulating the peripheral circulation and internal organ function. A five-seven day interval should be made after this course. In our opinion, quantum correction of homeostasis should be carried out in week-long microcycles. Therefore, in the basic training period, three microcycles of daily magnetic-infrared treatment should follow the immunomodulation regimen (with a week-long interval after its completion); a week interval follows and so on until the end of the period (3 + 1 protocol). Recommended dosages,

exposures and sites of low- energy laser treatment are presented in Table 2.

Table 2

Optimal dosage of low-energy laser radiation in the basic training period: Three microcycles of daily treatments with a subsequent one-microcycle interval (3 + 1 protocol)

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Cubital fossa	50	1	1	21
2. Apex beat	50	1	1	21
3. Liver	50	1	1	21
4. Spleen	50	1	1	21

Total dosage: 1,404 mJ

## 2.6. Quantum treatment during the strength training period

The strength training (special strength, speed/strength, maximum strength, endurance) encompasses the entire preparation period, varying with individual features of athletes and tasks of a specific phase of the training process.

It is recommended to use the low-energy laser treatment program described in the previous section during the basic-period strength training. This approach is appropriate in other periods of training. Rehabilitating and stimulating quantum therapeutic procedures in a specific period are defined as **somatic**, or **general**; additional treatment prescribed during the strength training is **special**. Table 3 presents special procedures of low-energy laser treatment during different phases of strength training. Their purpose is improvement of blood circulation, muscle nutrition and energetics, and reversal of metabolic disorders, including acidosis.

Table 3.

Special quantum procedures for various types of strength training (to be given in the gym after the warm-up, before and after major series).

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
Major muscles:			
1. Biceps	5	1	2
2. Triceps	5	1	2
3. Deltoid	5	1	2
4. Major pectoral	5	1	2
5. Forearm	5	1	2
6. Abdominal	5	1	2
7. Femoral flexor	5	1	2
8. Femoral extensor	5	1	2
9. Sural and others	5	1	2

Course (days): during the training, before exercise series for a specific muscle group and immediately after it (circular and variable series, superseries, others).



## **2.7. Quantum treatment during flexibility training**

Flexibility is an important constituent of the athlete's physical condition. Special exercise for improving flexibility is carried out throughout the sport season. Its intensity and pattern depend on the individual, genotype-related condition of the locomotor system and joints. This training should take account of methodologic errors of previous seasons, especially aftereffects of prolonged use of steroid drugs or an imbalance in strength training. Special procedures of low-energy laser treatment combined with regular somatic treatment (3 + 1 protocol) are recommended during the flexibility work (Table 4).

Table 4

Special quantum procedures recommended for use during flexibility training.

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Myoneural junctions	5	1	2
2. Joints, ligaments	5	1	2
3. Spine	5	1	2

Course: during the training - before a task and immediately after its completion.

## 2.8. Special training period

Strain builds up in the special training period, while the general amount of practice remains unaltered. Adequate control of fatigue and recovery is very important for the development of a new quality of organ and system function. Persistent overstrain coexisting with inadequate recovery is typically a result of errors in biomedical support which leaves the trainer unalerted to this imbalance; overlooked, it can trigger disease.

A major task in this period is to obtain a maximum biological effect of each special practice without inducing abnormalities and, should they occur, reverse them by efficient correction of homeostasis.

General and special magnetic-infrared laser treatment can seriously aid an athlete during the hard training. It is recommended to use the 3 + 1 protocol (see above) for the general-purpose treatment throughout the special training period (Table 5).

Table 5

General procedures of low-energy laser treatment for use during the special training period

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Cubital fossa	50	2	1	21
2. Apex beat	5	2	1	21
3. Liver	5	2	1	21
4. Spleen	50	2	1	21

Total dosage per course: 1,480 mJ

Special low-energy laser procedures should be combined with the somatic treatment presented above before hard training (Table 6).

Table 6

Special low-energy laser procedures recommended for use before a high-intensity task.

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
2. Apex beat	50	1	1
3. Liver	5	1	1

Course: 10-15 minutes before the warm-up for intensive special practice.

## 2.9. Result achievement period

The coach and the athletes need real help in the period of result achievement, like in previous training periods. Adequate knowledge of the organism backed by regular examinations assist them in result planning and achieving at this crucial time.

***It should be stated that the parameters of low-energy laser treatment recommended by us for use in top achievement sport can be individually adjusted by specialists for a maximum effect, with proper biochemical, hematologic and other tests describing the condition of athletes in their charge.***

***Athletes in any sports*** should use the regenerative, antioxidant, trophic, stimulating and other therapeutic effects of low-energy laser radiation during medical support of the training process, after immunomodulation and during the basic and special training periods.

However, applications of quantum therapy are ***specific*** in different sports which fall in five categories:

1. Cyclical (swimming, etc.);
2. Technical (yachting, etc);
3. Games (water polo, etc.);

4. Martial (judo, etc.);

5. Complex coordination (slalom, etc.).

This specificity will be discussed in further sections.

The period of result achievement is in turn categorized into precontest and contest phases.

### **2.9.1. Precontest-period quantum medicine**

A gradual reduction of strain in the special training period allows a smooth transition to precontest preparation, the first phase of the result achievement period. Some practices with a maximum heart rate are characteristic at this time for cyclical sports. Effective medical support in this period contributes to an optimum condition of an athlete for training of adequate intensity. Quantum medicine has an extremely important role in the range of supportive methods at the precontest phase.

We offer below regimens of low-energy laser treatment for precontest preparation of athletes in different sports. Somatic uses of magnetic-infrared laser treatment should be patterned so that it is finished two days before the contest. The treatment should use a 1 + 1 protocol (a week-long interval after daily procedures during one seven-day microcycle).

Table 7

General (somatic) quantum therapeutic procedures for use during precontest preparation of athletes in cyclical sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Cubital fossa	1,000	2	1
2. Liver (right subcostal space)	5	2	1

Course: seven-day microcycle.

Table 8

General quantum therapeutic procedures for use during precontest preparation of athletes in technical sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Apex beat	50	2	1	7
2. Liver (left subcostal space)	2	2	1	7



Table 9

General quantum therapeutic procedures for use during precontest preparation of athletes in game sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Cubital fossa	1,000	1	1	7
2. Apex beat	1,000	1	1	7

Table 10

General quantum therapeutic procedures for use during precontest preparation of athletes in complex coordination sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Cubital fossa	50	2	1	7
2. Lumbar plexus	5	2	1	7

Table 11

General quantum therapeutic procedures for use during precontest preparation of athletes in martial sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Apex beat	50	2	1	7
2. Cervical plexus	5	2	1	7
3. Lumbar plexus	5	2	1	7

The use of the recommended general quantum procedures during the precontest period in different sports does not preclude special-purpose magnetic-infrared laser treatment which was presented in previous sections.

### 2.9.2. Quantum medicine and contest

Substantial experience with applications of quantum medicine in the contest period has convincingly demonstrated the benefit of its powerful **stimulating** and **antioxidant** effects. Specialists involved in biomedical support of this period should provide the trainer and the athlete with individualized quantum stimulation regimens adjuncted by other means. Specialists should stand by both during maximum-intensity performance and at the early phase of precontest preparation, controlling the laser treatment by biochemical, hematologic, ECG, EEG, microcirculation and other tests, and in the contest period. There are no all-embracing prescriptions. The current achievement in sport is so high that the training process preceding success should be carefully designed and scientifically validated. And each component of the future success should be optimized in a most individual way.

Principles of quantum treatment in the period of result achievement apply for precontest and contest phases. Somatic quantum treatment in the precontest preparation have been reviewed by us in the previous

section. Immediately before the start, a quantum therapeutic procedure may be used:

- (a) only after a warm-up;
- (b) 35-45 minutes before going into contest;
- (c) but not later than 20 minutes before the start;
- (d) by contact, without undressing an athlete but only baring an area to be treated.

All general or special regimens of quantum treatment should be stopped two days before contest.

It is recommended to repeat the procedure if an athlete performs several times during one contest. Tables below present special low-energy laser procedures for use during the contest period.

Table 12

Special quantum procedures for use before the start in cyclical sports.

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Apex beat	50	5	1
2. Liver	5	5	1

Table 13

Special quantum procedures for use before the start in technical sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Cubital fossa	50	5	1

Table 14

Special quantum procedures for use before the start in complex coordination sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Apex beat	50	2	1
2. Lumbar area	5	5	1

Table 15

Special quantum procedures for use before the start in game sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Apex beat	5	2	1
2. Cubital fossa	50	5	1

Table 16

Special quantum procedures for use before the start in martial sports

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day
1. Cubital fossa	50	5	1
2. Abdominal aorta	5	5	1

**2.10. Use of quantum medicine during adaptation to conditions of other continents, time zones, climates and temperatures**

Efficient biomedical support of top achievement sport and the arsenal of modern methodologies offer a real assistance to adaptation of the organism to different climatic and temperature conditions or time zones.

Systematic use of quantum methods in medical support of the training process appreciably facilitates the adaptation. A special two-day quantum treatment on arrival at a different continent or time zone speeds up the adaptation process.

Table 17

Special quantum procedures for hastening adaptation to other continents, climates and time zones.

Treatment area	Frequency (Hz)	Time (min)	No. of procedures per day	Course (days)
1. Epigastrium	5	1	1	2
2. Kidneys, left	5	1	1	2
right	5	1	1	2

### 2.11. Quantum medicine and disease in top achievement sport

Disease in top achievement sport is peculiar in that it is usually related to ***aftereffects*** of methodologic errors, inadequacies or a lack of medical support of the training process, unjudicious prolonged use of dangerous drugs, including steroids. Even the intercurrent diseases cited in Chart 2 are definable as aftereffect conditions related to inability of a specialist to see in time health vulnerabilities of an athlete; these may be brought out by mental, emotional and physical strain of training. A lack of knowledgeable immunomodulation, proper medical or surgical treatment facilitates their onset.

### 2.11.1. **Aftereffect diseases and quantum medicine**

**Aftereffect diseases** in top achievement sport are definable as **occupational** ones. Their causes and ways of their prevention have been repeatedly addressed in this book - methodologic errors, prolonged use of dangerous drugs, a lack of adequate biomedical support of training, to name a few. **The key goal of this book is to demonstrate the role of medical science in disease prevention in sport, apart from assistance to steady improvement of athletes' results.**

Organs and systems that are most vulnerable to diseases in top achievement sport are:

- cardiovascular system (mitral prolase);
- hemopoietic system (anemia);
- immune system (immunodeficiency);
- gastrointestinal tract (gastritis, ulcer);
- liver (hepatosis);
- locomotor system (arthrosis).

Each specialist working in top achievement sport, especially its biomedical support, is confronted by these and similar problems. Reasonable, prolonged and sys-



tematic use of quantum medical methodologies in the range of other means may result in a complete recovery.

**Example 1:** A world swimming ex-champion, 26 years, with grade 2 mitral prolapse (6 mm), hepatitis, excessive hepatic enzyme levels and prominent insufficiency of glycolytic gluconeogenesis.

Careful control of exercise (open air exercise should not be stopped in the presence of prolapse), systematic evaluation complete with ultrasound, relevant medication, immunomodulation and daily use of quantum therapy at short intervals were carried out for five months. The athlete meticulously complied with all recommendations. These interventions reversed the prolapse and hepatitis. Follow-up findings indicating the recovery are filed in Moscow's Cardiac Research Center and in our center. Examples of abnormalities in top-notch athletes are unfortunately numerous. And quantum medicine, along with other therapies, helps avert the transition of such conditions to **diseases of aging** (in opinion of American researchers, ischemic heart disease, cancer and diabetes mellitus are aging-associated diseases which eventually lead to death).

**Example 2:** A marathon swimming champion of Europe and Russia, 23 years. His diagnosis was hepatitis with very high hepatic enzyme levels and severe anemia (Hb, 9.5). Systematic use of principles described in the first example combined with prolonged quantum therapy yielded a complete recovery within four months and his winning in a world championship three months later.

**Example 3:** A female slalom champion of Slovenia, 25 years. She was diagnosed with posttraumatic arthrosis, iron-deficiency anemia and immunodeficiency. Prolonged combined use of quantum therapy and the above mentioned methods resulted in a recovery within seven months. She scored a series of victories and the title of the world's best in slalom in a subsequent season.

The goal of this section is to illustrate the need for use of quantum medical methodologies not only in bio-

medical support of training but also in the management of abnormalities which have been overlooked by specialists and progressed to persistent disease.

We did not plan to offer in this section general and special regimens of quantum therapy for specific conditions, as recommendations at large are not applicable in such situations. To make them is a prerogative of specialists who follow up an athlete and who are in position to efficiently treat and rehabilitate their charge relying on relevant literature and knowledge of the athlete's organism.

### **2.11.2. Quantum medicine and treatment of intercurrent diseases**

Treatment of intercurrent, or associated diseases in top achievement sport has its peculiarities which are well known to specialists, but conventional approaches and interventions are used in most cases. Ample possibilities of quantum medicine make its method a valuable tool for pathogenetic and symptomatic treatment of intercurrent diseases. Abundant literature on this topic should enable specialists to efficiently manage these diseases to prevent their chronic progress (43, 44).

## **Afterword to «Quantum medicine in top achievement sport»**

Quantum medicine as a sum of knowledge and methodologies for correction of athletes' homeostasis throughout the training process and during contest is an integral part of biomedical support of top achievement sport. Antioxidant, immunostimulating, bionormalizing, regenerative, trophic, drug-potentiating and other effects of quantum therapy are essential for the organism of an athlete during the training. One of practical tasks of modern quantum medicine is the development of special equipment for assisting top achievement sport.

This rapidly expanding field of knowledge has huge prospects. The spectrum of its benefits has significantly broadened within a short time. There has been a change in the understanding of the strategy of quantum therapy. Knowledge of molecular, cellular and biophysical mechanisms underlying the action of quantum therapy has expanded. Extensive available evidence and continuing in vitro and in vivo research in this field will provide much deeper insights into mechanisms of clinical effects that originate at subtler levels. What is more, progress in quantum medicine is bound to move us closer to finding

specific and valid applications of quantum methodologies in combination with drugs in the management of a spectrum of diseases, including the most severe ones. In fact, a new field of medical knowledge, a scientific thinking of the future is in the making.

***A key to success is understanding a problem and its quiet handling***, the introduction of this book said. In our opinion, another spiral of progress with practical use of the rapidly evolving area of health care, quantum medicine, will follow serious fundamental research to provide a starting ground for a breakthrough into the future.

A deep bow of respect is due to our outstanding compatriot researchers and designers of Quantum Medicine Association, an offspring of the Special Design Bureau which is a space company at the Moscow Power Engineering Institute. At present, the office-enterprise-association triad is a leader in quantum medicine in Russia and Europe. Our center "Sport of the 21st Century" fruitfully cooperates with this organization. A great amount of work to restore health of athletes was done and this section of the book written owing to its leaders A.Y. Grabovshchiner and N.N. Kisanova.



## Summary

The closing years of the outgoing millennium have seen enormous problems and cataclysms in society, but also a significant social progress. These processes are seen both in Russia and elsewhere in the world. It is a historical fact that ***the higher are living standards the more acute are problems of prolonging the life expectancy.***

A healthy lifestyle, extensive use of health improvement facilities, the search for means of rejuvenation, such as bionormalization, immunomodulation, sport, natural foods and regular medical checks, are a "gentleman's set" of a healthy individual this day.

Progress in medicine and biology, and the revolutionary technological breakthroughs accompanying it open new prospects of health maintenance and prolongation of human life, with sport as one of prerequisites for it.

The banal but everlasting truth is that health is the greatest wealth. With possibilities available to modern medicine, almost everything can be learned about health of a person in a matter of 20 minutes and found abnormalities be alleviated by rapid interventions. Such

progress in diagnosis and therapy of early-stage abnormalities reminds one of not-so-old pioneering steps in fiberoptic technology in Japan, where the systematic screening of the personnel of interested companies ruled out gastric ulcer and cancer.

Regular and full health evaluation is the first and foremost step toward longevity. Only objective evidence of the condition of the organism allows the control of exercise, adjustment of nutrition and efficient steps to reverse occurring abnormalities. This understanding and health attitudes mark civilized societies at present. Sport should have a great role in achieving longevity - and top achievement sport with its new concepts too, however paradoxically this might sound from the standpoint of the lingering dogma which relates the strain and costs of top achievement to health damage. The sport movement reflects social development of society like a mirror. Outstanding athletes are a pride and symbol of prosperity of their nations, their gene pool and future. Even at times of hardship, society finds funds for development of sport and tries to give its best to athletes. What is at issue is in which direction the modern sport movement is to develop and **what** use it should make of the nation's support.

The motto ***Toward Longevity and Top Achievement in Sport without Doping*** is no showcase words - it is the meaning and principle of top achievement sport today. Everybody with any part in sport should turn their face to health of athletes and do their work just from this perspective.

Biomedical support of top achievement sport is leaving its traditional boundaries of sport medicine as it is summing up fundamental knowledge of almost all medical disciplines and many areas of biology.

***Just fundamental knowledge of common or major mechanisms, and not long-term studies of a diversity of individual responses is needed in sport today.*** This will allow ***to prevent disease in sport*** in a



near future, often **disease of ignorance and thoughtless attitudes**. Sport-related diseases and their aftereffects have their roots in poor social protection of athletes and a lack of concept, resulting in a messy thinking and focus of coaches or specialists on secondary manifestations, with major outwardly inapparent processes remaining overlooked. Sometimes this leads coaches and athletes to resort to a variety of drugs or food additives which are widely advertised, although some are harmful, to secret intake of new-generation steroids which they believe are undetectable by doping tests and to useless overstrain.

Russian science has generated very many original technologies that have no counterparts in the world. Specialists of biomedical support of top achievement sport should recruit in their daily practice what may be of use in preparation of athletes, with the provision of systematic **diagnostic** evaluation allowing **individual readjustment of the training process** to make fatigue optimal and **recovery** fast. This follow-up should include controlled **immunomodulation and metabolism bionormalization, pharmacologic and physiotherapeutic** support of organs and systems which are genotypically most vulnerable during hard training, and individualization of training regimens in precontest and contest periods.

Permanent looking up to Western pharmaceutical achievements, secret and inappropriate use of Western drugs in expectation of a miracle, intuition-guided borrowing of training programs, short-lived success should give place to carefully planned, science-supported and stable extra class results.

The proverbial "There are no heroes in one's own country" is not true for the present-day situation in sport. Russia is incredibly rich in talented youth, a reserve and promise of future national teams. With an appropriate training concept in place, the current powerful line-up of our athletes can make their fans happy more than once.

Very serious scientific potential, able sport administrators and real steps to involve our sport standouts in the leadership of the international and Russian sport movement leave one hopeful. The backing of the Russian leadership and the president to sport is obvious. Society is keen on success of its athletes. All of this should be made a good use of. A new concept of training should be formed on the basis of the huge available experience, with involvement of the most knowledgeable in this field.

We are convinced that reasonable use of the excellent scientific basis and highly skilled cadre in preparation of the talented sport youth, in which Russia was always rich, will allow it to return its grandeur in the international sports arena. We must be Swifter, Higher, Stronger!

## Post script

This book is devoted to our friend, marathon swimming pioneer, Merited Trainer of Russia Sergei Nikolayevich Kustov, who died at 40 years in October 2000. He taught and coached outstanding athletes, world leaders in swimming marathon, a discipline of extreme physical and psychoemotional strain. They are world and Europe champions A.Akatyev and E.Bezruchenko, Europe champion O.Guseva. We are convinced that his pupils will continue with dignity the endeavor of their **teacher. Sergei Kustov will be sadly missed.**

The swimming youth, ten years of coaching work at Moscow's Dinamo Club simultaneous with study in the medical institute and a postgraduate course, many subsequent years of research, meetings and cooperation with prominent people in science and top achievement sport have molded the outlook of the author and led him to write this book.

His tribute is due to

Russian swimming legends, Merited Trainers of the USSR N.M.Nesterova, L.E.Soboleva, I.Y. Kistyakovsky, N.F.Kryukova;

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and certainly E.I.Panina, the friend and comrade-in-arms, one of co-founders and director of the International Center "Sport of the 21st Century", whose personal contribution to preparation of many known athletes are difficult to overvalue.

In summary, grateful mention is due to known specialists who have contributed to or are participating in research of the International Center "Sport of the 21st Century";

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N.N.Kisanova, director of Quantum Medicine association, participant in quantum medical research in top achievement sport.

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