Computer Pulse Diagnostics Manual

puls-as

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PREFACE

For a "western" doctor who is at the beginning of being acquainted with traditional Chinese medicine (TCM), comparison of the terminology of modern and Chinese medicine, the "translation" of terms and concepts into a language that Europeans understand becomes a stumbling block. The difficulties that arise compel him to either completely abandon the use of TCM in his practice, or use the classical knowledge and the TCM system "separately" from each other, as they say, not to confuse the sins with the righteousness. Discussions are still ongoing about whether it is possible to explain, and therefore, understand from a scientific point of view, the terms and postulates of traditional Chinese medicine. For this, naturally, attempts are made to describe ancient models and concepts in terms of the sum of modern "scientific" knowledge and use well-known terms. This refers to knowledge that is obtained using the methods of "evidence-based medicine" and which have theoretical models for their explanation.

The participants of the discussions hold mainly one of two opposing points of view. Supporters of the first believe that it is fundamentally impossible to compare, and even integrate one medical system into another, as the terms, concepts and models of TCM are primitive and archaic. The other side, which is in a clear minority, is confident that such integration is possible, but there is as yet no clear understanding on which conceptual basis such a union can occur. Numerous attempts to identify the Qi substrate failed. Attempts to determine anatomical formations that would correspond to the channels of the body (in Russian-language literature they are called meridians) were also unsuccessful. The attempts to draw a parallel between the Western diagnosis and the diagnosis in terms of TCM were also unsuccessful. However, there is a third party that does not participate in discussions about mutual integration at all. This includes, firstly, those who consider any oriental, alternative, and traditional medicine, including Chinese medicine, not worthy of the attention of a modern "progressive" doctor.

> **Note.** Interestingly, there are supporters of this opinion in China itself. It turns out the phenomenon of "do not value what is ours" is characteristic not only for the Eastern Slavs. Our communication with many citizens of China leaves the impression that many Chinese people resort to TCM methods only after they have tried the basic Western methods – surgery, antibiotics and etc. (modern China has long been integrated into the global community in this sense).

Secondly, quite numerous ardent supporters of orthodox TCM. In this category of specialists, any attempts to integrate the two medical systems cause only arrogant smirks. Time and the patient will judge. And we can only say one thing: each doctor decides for himself which point of view is the closest and most correct to him. We hope that this book will help making the choice more reasonable.

The experience of TCM not only covers a period of several thousand years but has preserved descriptions of this experience. You can still study the experience of old doctors in libraries. The modern physician only needs to delve into the terms and understand what physiological processes in the body they reflect. Doctrors already all did this when they started studying Western medicine. It must be remembered that modern technological medicine has emerged and is based on the experience of previous generations. For the last century, the western world has been developing technologies in medicine, both in diagnostics and in the manufacture of treatments or medicines. Therefore, the concept of 'evidence based' is correct when it comes to research tools or the industrial production of medicinal substances. Treatment cannot be a conveyor process because all people are different and live in different rhythms. The mechanical view that all people are equally constructed is not correct. The overlap of the structure or functional activity (physiological phase) of certain individuals are exceptions to the rules, not the rule. If this

is forgotten, hundreds and thousands of patients will die from the use of 'evidence-based' medicines

It is important for a modern physician to track how the body will respond or respond to a chosen treatment. Whether the physiological condition allows the use of one or other of the drugs and, after use or the treatment cycle has been achieved, what changes need to be made. One of the tools that can help to individually and systematically assess the patient's physiological processes and their changes is pulse diagnostics. Pulse diagnostics has historical recognition in all medical traditions and forms.

Technological developments have led to the development of a computerized pulse diagnostics system. This allows to systematically assess the functional activity of the body's systems in various parameters and aspects, to objectively record data and to perform repeated examinations in order to assess the change in the condition and the effectiveness of the treatment. The method of hardware pulse diagnostics (HPD), offered to the reader's attention, was developed on the basis of traditional Chinese medicine, which is close and understandable to the authors of this book. Initially, we set ourselves the task of objectifying the method of manual pulse diagnostics using modern equipment and a computer. But as is often the case in research work, we received an unexpected result for us. On the one hand, the method obtained originally posed the tasks, of course, fulfills and improves the quality of work of a doctor who does not know the manual pulse diagnosis. However, he still loses to the experienced classic pulsodiagnosist. On the other hand, it turned out that in addition to the planned capabilities, the HPD method opens up prospects in two areas at once: 1) functional diagnostics of organs and systems; 2) psychosomatic diagnosis. In this sense, the HPD method serves as a bridge, unique in its capabilities, between traditional Chinese medicine and modern scientific medicine. Extent to which is true is for the reader to judge.

INTRODUCTION TO TCM THEORY

To understand pulse diagnostics further, it would be more than useful to look into the roots of diagnosing by pulse – Traditional Chinese Medicine. Traditional Chinese medicine, abbreviated as TCM, is a scientific summary of the experiences of the Chinese nation in struggling against diseases for thousands of years. TCM considers that the body is a carrier of the mind which depends on the body existence; and in turn the mind serves the body which is toughened by the mind. TCM has always paid attention to a varied influences of the natural environmental variations on human life activities and demands that the observation and research on the human vital activities can't be limited in the human body itself, but should be placed in a vast background of the natural world, in which the various natural factors acting on the human body could be comprehensively and systematically inspected so as to raise the level of health care through correct diagnosis and treatment of diseases.

Holism is a basic principle of TCM. TCM thinks highly of the human body's unity and integrity itself as well as the connection between man and nature. It holds that the human body is an indivisible organic whole in which all parts constituting the body intercommunicate structurally but being inseparable, interpromote and interdependent functionally, and interact pathologically in reciprocal causation. The multiple connections exist between the human body and its external environment, and these connections commonly maintain and steady its own vital activities in the course of adapting to and remaking the natural and social environments unceasingly. The treatment of TCM is chiefly decided by the conclusion of pathogenesis instead of the diagnosis of disease. All things with the properties or appearance to the sun belong to Yang; conversely, those contrary to the sun to Yin. For example, anything possessing the characteristics of warmth, brightness, daytime, clearness, motion, fire, etc., pertains to Yang; whereas, anything that is cold, dark, in nighttime, cloudy, quiet, watery, etc., to Yin.

Table 1. Classification Form for Attributes of Yin and Yang

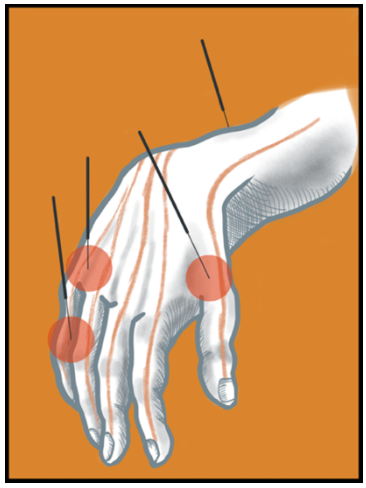
Attributes	Space	Time	Degree of heat	Humidity	Weight	Brilliance	State of movement
Yang	The upper interior	Daytime Spring Summer	Warmth Heat	Dryness	Heaviness	Brightness	Motion Ascent Excitement Hyperactivity
Yin	The lower exterior	Nighttime Autumn Winter	Cool Cold	Dampness	Lightness	Darkness	Quietness Descent Calmness Hypoactivity

Source: Liutong, Z. & Zhaozhi, C. (1996). *The Basic Theories of Traditional Chinese Medicine*. Wuhan University Press.

Basic TCM Theory

Short theory of five elements. The original meanings of the five elements were five categories of raw materials, namely, water, fire, wood, metal and earth, and where further thought of as the fundamental components constituting the material world, hence belonging to plain materialism. In order to illustrate and explain the various matters and phenomena, the ancient scholars classified them into the five categories according to he attributes of the five categories according to the attributes of the five elements by analogy from the appearances and deductive reasoning. Interaction among to five elements based on two basic relations: interpromotion and interretraint. The abnormal relations after breaking down of the normal interpromotion and interrestraint are mainly the over–restraint and reverse–restraint among them.

"*Zangfu*–organs" is a general term for the internal organs of the human body, and includes the five *Zang*–organs, the six *Fu*–organs and the extraordinary *Fu*–organs. The Heart, Lung, Spleen, Liver and Kidney are known as the five *Zang*–organs. The general functional feature of the Zang–organs is to produce and store the essence, Qi, blood and mind. The Gallbladder, Stomach, Small Intestine, Large Intestine, Urinary bladder and *Sia Jiao* are collectively known as the six *Fu*–organs. The general functional feature of the *Fu*–organs is to receive and digest foodstuff and transmit and excrete the wastes (stool and urine). The brain, marrow, bones, vessels, Gallbladder and uterus belongs to the category of the extraordinary *Fu*–organs. Like the six *Fu*–organs in morphology, they are in bag shape, but they can store vital essence like the five *Zang*–organs in function. They are, therefore, called extraordinary *Fu*–organs.

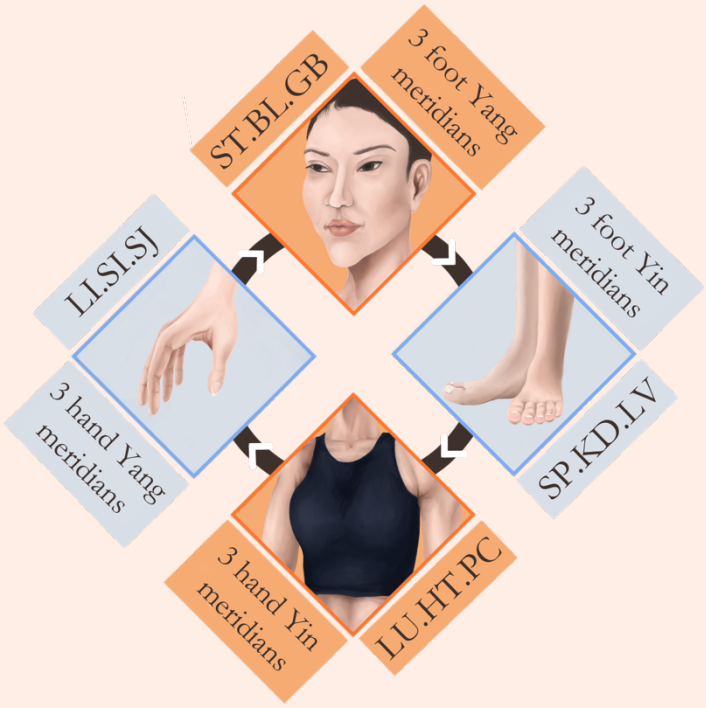


The essence, Qi, blood and body fluid, together called essence–Qi are fundamental substances for constituting the human body and maintaining its life activities. The theory of essence, Qi, blood and body fluid is an important component of TCM theoretical system and plays a major role in it.

Areas affected during acupuncture needling:

Brain;
Spinal Cord;
Hypothalamus;
Pituitary;
Adrenals;
Voluntary muscle movement;
Smooth muscles;
Stress/Emergency response;
Nerves.

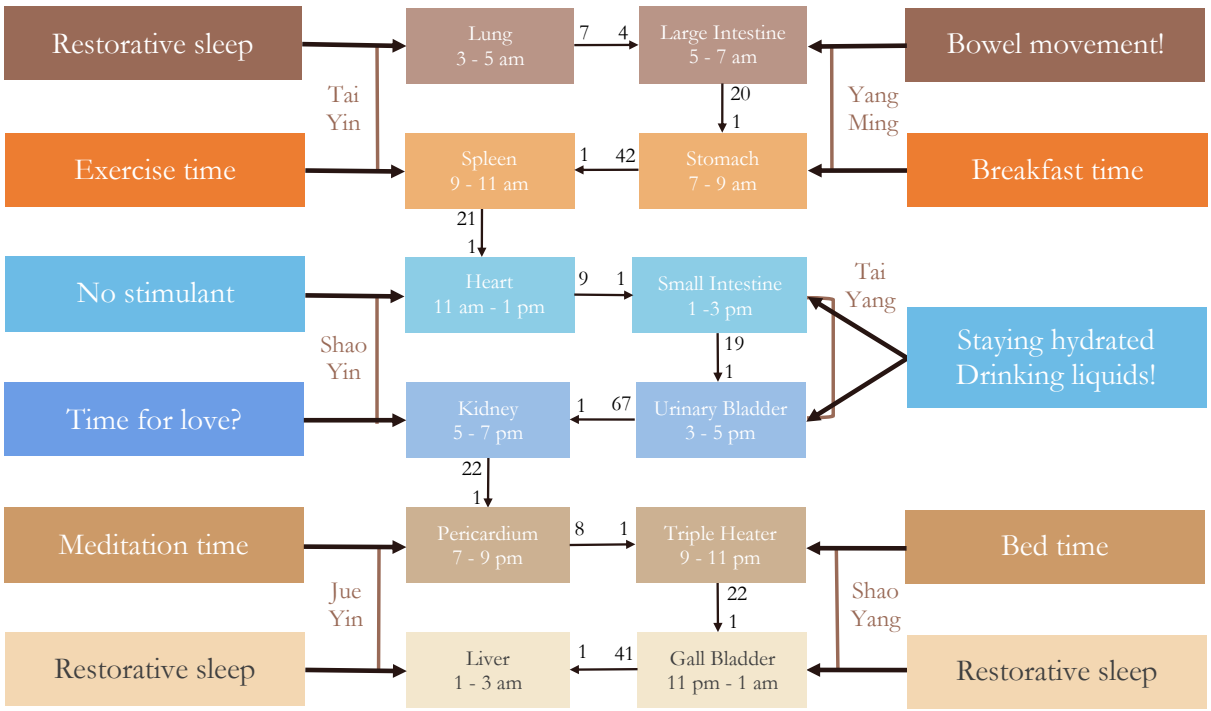
The doctrine of meridian or the theory of channels and collaterals, deals with the physiological functions, pathological changes of the channel system and their relations with the Zangfu–organs. It is essential part of the basic theories of TCM like the theories of Yin–Young and five elements, Zangfu–organs, essence, Qi, blood, body fluid, etiology and pathogenesis. It is theoretical basis of all clinical departments of TCM, especially that of acupuncture (as an example, theoretical background of acupuncture is presented on the left), moxibution, massage and Qigong practice. The study of TCM theoretical system with modern science and technology will sure bring about a breakthrough in the progress of TCM and will further promote the popularization of TCM in the world.



The cyclical flow of Qi within the channels:

The flow of Qi connects each channel to the next and back to the first one, forming a full circle. The flow of Qi goes in this order: LU, LI, ST, SP, HT, SI, BL, KD, PC, SJ, GB, LV, back to LU, forming a continuum. In order for the flow to reach both sides of the body, the LI meridian is the only one crossing the body to its opposite side.

The cyclical flow of Qi in the meridians in a 24hr day



METHOD OF MANUAL PULSE DIAGNOSTIC

There are several options for pulse diagnosis in traditional Chinese medicine. They differ, first of all, by pressing methods on the artery and the so-called "depth" of palpating the pulse. It is postulated that a pulse corresponding to various organs and systems is detected at various depths. For example, in the treatise "Nanjing" it is written that the pulse is first examined, pressing with a force equal to the weight of three peas. The skin, hairs, and Lungs are examined in such way. Pressing with a force equal to the weight of six peas, they examine the blood, blood vessels and the state of the Heart. Pressing on the artery with a force similar to the weight of nine peas, examine the muscles and condition of the spleen, pressing with a force equal to the weight of twelve peas, examine the tendons, ligaments and LIVER condition. By pressing an artery to the bone - bone, Brain, and Kidney conditions are examined. Thus, at each point, the pulse is evaluated at five depth levels. Moreover, each level characterizes the five main functional systems of traditional Chinese medicine.

This method of pulse diagnosis is complicated, first of all, by the fact that it is rather difficult to determine each of the five levels of pulse palpation. Therefore, the most commonly used technique is the palpation of the pulse at a superficial and deep level at six classic points shown in Fig. 1.

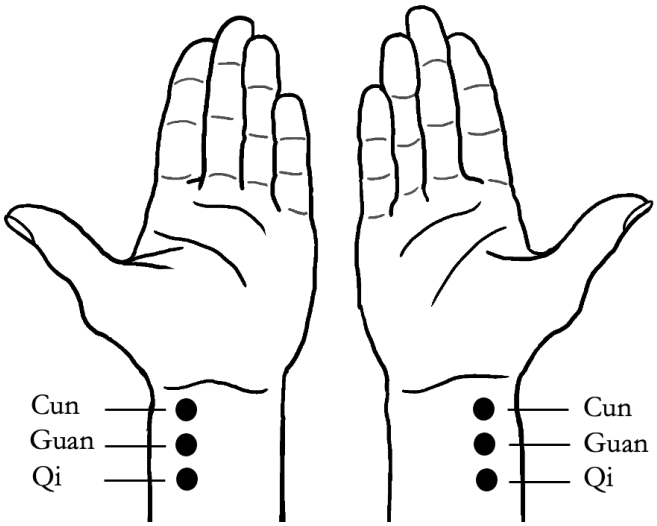


Figure 1

The **guan point** is located where the process of the radial bone is felt under the fingers. If we move from it proximally up the artery, then the **qi point** is determined at a gap of one inch. If we move from the guan point distally towards the point, then on the interval ... the **point cun** is determined. During diagnosis, the index finger rests on the cun point, the middle finger on the guan point and the ring finger on the qi point on the patient's right and left hands, so that the doctor simultaneously feels the pulse on the right and left.

At the same time, the cun point on the left hand corresponds to the primary element Fire (organs Heart and Small intestine), guan - to the primary element Tree (organs Liver and Gall bladder), qi to the primary element Water (organs of the Kidney and Bladder).

Notice. To avoid confusion, hereinafter we capitalize on the names of primary elements, elements, pathogenic factors and major organs, which we use as terms and concepts of TCM.

On the right hand, the cun point corresponds to the primary element Metal (Lung and Large intestine organs), the guan point - to the Earth primary element (Spleen and Stomach organs), the qi point - to the Fire primary element (Triple Heater and Pericardium organs). See table 1.

Table 2. Classic Pulse Diagnostic Points

Points	Level	Left arm	Right arm
Gun	Superficial	Large intestine	Large intestine
	Deep	Heart	Lungs
		(Fire)	(Metal)
Guan	Superficial	Gall bladder	Stomach
	Deep	Liver	Spleen
		Wood	(Earth)
Qi	Superficial	Bladder	Triple heater
	Deep	Kidney	Pericard
		(Water)	(Fire)

Pulse characteristics are evaluated at two levels: superficial and deep. With light (superficial) pressure, a superficial pulse is determined, with strong - accordingly deep. It is believed that the superficial pulse reflects the state of the so-called hollow organ, and the deep pulse reflects the dense. However, there is also an opinion that with pulse diagnostics, the superficial pulse does not have independent significance and reflects the Yang of the corresponding dense organ, and the deep pulse shows its Yin. This does not contradict the first statement in any way since the points of cun, guan, and qi relate primarily to the primary elements of the WU-Xing model. And according to the laws of the WU-Xing model, the corresponding pairs are the hollow/dense organ, where the hollow organ is Yang and the dense organ is Yin. It is important to note here that the pulse directly reflects the state of the main organs and not the channels (meridians). The condition of the channel of the corresponding organ can be determined or, rather, assumed only by indirect signs.

The surface level is as follows. At the most superficial pressure on the artery, only the top of the pulse wave is felt. Increasing the pressure slightly, to feel the full pulse wave, the doctor falls on the surface level of the pulse study. A deep pulse level is found by pressing on the artery to squeeze the blood flow. Then the pressure on the artery is gradually reduced so that the blood flow resumes, and a complete pulse wave appears under the finger. At this depth and a study of a deep pulse is carried out.

It is impossible to unequivocally say with what exact force you need to press the artery to reach a superficial or deep pulse. The pressure force is always determined relative to the above parameters, it is different each time and depends on many factors. And the very depth of the superficial and deep pulses has its diagnostic value. The same patient's depth of the pulses may vary in accordance with changes in his condition during the day or even several hours. Besides, there are normal seasonal changes in the depth of the pulse. For example, in winter, the pulse of healthy people lies deeper than in summer.

According to the rules of TCM, the study of the pulse must be carried out immediately after waking up, while the patient should not eat or drink, and should also be in a state of complete peace. This is due to the rapid pulse response to any changes in the body, and to eliminate the "information noise" complete physiological and psychological peace of the patient is required. In modern conditions, it is, of course, difficult to comply with these rules. Nevertheless, during the diagnosis, you should limit maximum factors that can distort the picture of the pulse. If it is impossible to eliminate external disturbing influences, then they should be taken into account when analyzing the data obtained. External influences are taken into account either as random disturbances or as the influence of pathogenic factors.

When examining the pulse, the patient should be in a sitting position, and his hands are at the level of the heart. The surface of the palm should be facing up, the forearm extended forward to prevent interference with the free movement of blood. By clicking on the artery at the indicated points, the specialist, figuratively speaking, "listens" to the pulse with six fingers, conducting diagnostics in the "interactive mode". At least 28 different types of the pulse are distinguished, however, experienced diagnosticians distinguish six hundred or more of its types.

When diagnosing, attention is paid not so much to the speed (fast or slow) and the rhythm (uniform, intermittent) of the pulse, but the quality of the pulse beat (full, empty) and its position (in-depth or on the surface). Besides, the more delicate palpation characteristics of the pulse are evaluated which have to be described figuratively. For example, among the superficial pulses, there are smooth, rough, slippery and sticky ones. Among the deep pulses, empty, excess, compressed, hidden and tense ones are described. In ancient treatises, we find a description of the pulse, which is compared with a string and a hook, which can be like a hair or a pebble. The pulse is described as a passerine beak or is similar to water flowing down dropwise, etc.

In this way, the doctor receives diagnostic information. And now we will very briefly dwell on the principles of interpreting the data obtained. This moment of pulse diagnostics is no less complicated than the first one. To make a diagnosis by pulse, it is necessary to carry out several logical operations, to analyze the ratio of at least twelve variables. This analysis uses three to eight models. Recall that the sensory sensations of the pulse diagnostics are analyzed.

The sequence of analysis for each doctor is his own, largely depending on personal experience and the specific diagnostic situation. If you try to formalize the algorithm for conducting manual pulse diagnostics, you will get a branchy algorithm in which the next step depends on the results of the previous one. In the general case, the diagnosis of the presence of a superficial syndrome is carried out first - superficial pulses are assessed at all points (it is determined whether there is an external pathogenic factor affecting the function of the hollow organs). Then an assessment of deep pulses is carried out – a diagnosis of the state of dense organs. In this case, the ratio of the characteristics of the pulses of various organs is analyzed using the WU-Xing model, husband-wife principles, etc. In addition, the superficial and deep pulse of each pair of hollow and dense organs is compared, determining the balance inside the primary element. The above comparisons are only basic. An experienced diagnostician can carry out others too.

Analyzing the information received, the doctor gets an idea about the presence of the Voidness or Fullness syndrome, differentiates the conditions of Cold and Heat, determines the pathogenic factor that caused the disease. In addition, affected organs and a pathogenetic relationship between them are necessarily detected. In addition to making a diagnosis, a pulsodiagnosist can predict the onset, development, and outcome of the disease.

Summing up, we can safely say that manual pulse diagnosis is not available to every doctor. Today, on the way to mastering the method a trained doctor may face many difficulties:

- the need to have high sensitivity;
- the problem of the formal transfer of teacher's personal experience;
- compulsory extensive practice in pulse diagnostics;
- complete incompatibility of the conceptual framework of eastern medical schools with modern classical medicine.

If you add to all this the almost complete absence of teachers you will understand what makes manual pulse diagnostics in our territory to be a high and exotic medical art, and why it is so difficult to introduce this method to wide medical practice.

MODERN JUSTIFICATIONS OF PULSE DIAGNOSTICS POSSIBILITIES

So, in traditional Chinese medicine, pulse diagnosis has been and remains a universal and accurate diagnostic method that allows you to diagnose a disease of any organ and system of the body. Can pulse diagnostics also play the role of a comprehensive, reliable and accurate method for diagnosing a wide range of diseases in classical Western medicine? The answer cannot be simple and unambiguous. First of all, it is necessary to decide whether it is even possible to talk about the diagnosis of a wide range of conditions and diseases by assessing the vibrational processes occurring in the body.

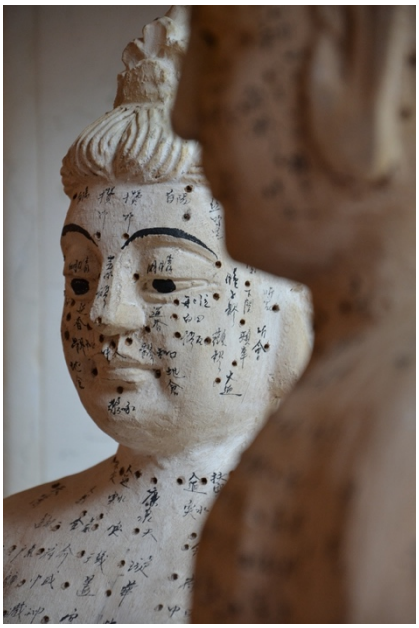


Image by Matthias Frank

The paradoxical, at first glance, diagnostic accuracy and prediction of the course of the disease, based on the assessment of the pulse characteristics, have been confirmed in modern works on the structural-spatio-temporal organization of living organisms, systems theory, biorhythmology, and functional biosymmetry. In recent decades, in biology and medicine, the structural approach to diagnostics and therapy is exhausting itself and, in its place, a functional one comes. The organism is considered as a complex multi-level functional system, consisting of a large number of subsystems. The parameters of the functions of absolutely all systems and their subsystems are constantly changing and continuously fluctuating [28]. In living organisms, the width of the "corridor" of possible fluctuations varies depending on external parameters – solar activity, changes in the gravitational field, temperature of the environment, etc. Internal factors also influence the degree of possible "freedom" of functions – humoral and nervous regulation, the body's vital activity phase etc.

Along with chaotic fluctuations in the activity of the functional subsystems of the body, rhythmic periodic processes are distinguished that make up the same hierarchy as the functional systems themselves. Rhythmic and periodic processes are a necessary attribute of any biological systems. All biological rhythms of a living organism are usually divided into long - and short-period. Long-period or ecological rhythms include solar (eleven-year), annual, lunar (twenty-eight-day), circadian (daily). These are exogenous rhythms, i.e. for the body, they are external, generated

by the environment. The main biological meaning of long-period rhythms in the body is the synchronization of internal physiological processes with macro- processes in the environment. This allows the body to adequately fit into the environment. Organisms are governed by long-period rhythms. For example, the time of onset of leaf fall or seasonal molting of animals mainly depends not on average daily temperature, but on the length of daylight hours.

Short-period rhythms (physiological) are considered exclusively endogenous. They reflect various periodic and oscillatory processes that take place inside the body. At the molecular, cellular and tissue level, this can be an alternation of the processes of synthesis and decay, activity and rest, accumulation and excretion. At the level of organs and functional systems, whole chains of coordinated rhythmic activity of various organs and tissues that functionally cooperate have been identified and form functional systems. It is the mutual coordination of activity rhythms that makes it possible to combine the work of organs into a single ensemble in the most appropriate way. At the level of the whole organism, the coordination of endogenous rhythms ensures the integrity of the organism.

On the one hand, the hierarchy of biorhythms is a controlling factor that ensures the integrity of the body and optimizes its activity at different levels. This hierarchy of interconnected rhythms is the most important factor in the preservation, formation and restoration of structural integrity. This function is performed mainly due to the regulation of metabolism. On the other hand, the organization of biorhythms is a complete reflection of the function of the structural elements of the body. The hierarchical organization of many rhythms of various levels is a reflection of the functions of three integrating and homeostatic systems of the body: nervous, endocrine and immune.

The functions of these systems are maintaining homeostasis, which is considered as the desire to balance while maintaining internal dynamics - the most important system-forming function of the body. Moreover, balancing occurs both in the internal environment of the body, and in relation to the interaction of the organism / environment. Consideration of the organism as an open functional system reveals the importance of external and internal harmony as the main factor in the life of the organism. Harmonious "fit" into the environment and the optimal use of external and internal resources to implement their own strategies are a prerequisite for the biological success of the organism.

Thus, it is obvious that the rhythmic structure of endogenous biorhythms, the degree and features of their hierarchy, mutual coordination, and interdependence fully reflect the state of the organism, the state of its functional systems. Moreover, one can indirectly judge the state of morphological structures of the body.

Studies of the diagnostic significance of endogenous biorhythms have been most intensively conducted over the past 20 years. The diagnostic significance of heart rate variability, the rate of expansion and contraction of the pupil, and the daily rhythm of heat sensitivity of acupuncture points were shown. A number of studies indicate that the rhythmic structure of physiological signals, which is determined by the vibrational components of functional systems of various levels, carries information about the state of the organism and its functional systems. In this case, the deviation of certain functions of the body is always preceded by hidden changes in the rhythmic organization of processes. The mismatch of the internal rhythms of the body – desynchronosis – is one of the earliest and most common symptoms of distress in the body.

The diagnostic significance of the rhythmic structure of biosignals is largely determined by the mutual relations of oscillatory processes, which reflect the functioning of various body

structures. Pulse oscillation of the arterial wall is the sum of many vibrational and wave processes that occur not only in the cardiovascular system, but also in the body as a whole. Therefore, the pulse signal carries diagnostic information about all the functional systems of the human body. Recent studies have convincingly testified to the great diagnostic information content of the peripheral pulse. The data of periodic fluctuations reflected in the characteristics of the peripheral pulse can be the basis of diagnostic data for constructing a functional diagnosis that reflects the state of the whole organism and its functional subsystems.

Image by Leon Gao

These views, confirmed by a number of fundamental studies, surprisingly correspond to the ideas of ancient Chinese authors that everything in a person obeys the laws of "sky" (external environment), "earth" (internal, hereditary essence) and rhythm. The ancient Chinese were not only aware of the various biological cycles of the body, from two hours to seven years, but their hierarchy and relationship were also known. Moreover, in ancient Chinese treatises it was argued that violations of the coordination of human rhythms and the rhythms of nature lead to the onset of the disease.

In the mid-twentieth century, considering the human body as an open functional system was a revolutionary step in modern biology and medicine. And in traditional Chinese medicine - such an approach to the analysis of man and his health has been the only one possible for millennia. Based on these positions, a person is considered to be healthy when he adequately fits into the changing rhythms of the environment. And on the contrary sick when desynchronization occurs, the rhythmological mismatch of their own endogenous rhythms with environmental rhythms or "internal" relationships of endogenous rhythms. It is quite clear that the diagnosis of the state of the disease from this point of view involves the identification of an imbalance, a violation of the harmony of the rhythmic integrity of the organism.

Indeed, no matter in what context a person is considered, the consent or disagreement of a person's state with the state of his surrounding nature (environment) — season, time of the day, weather, etc., is always taken into account. In this case, the absolute characteristics of body parameters, such as pulse, are not so important. More important is the fact of the correspondence or inconsistency of these characteristics with the characteristics of nature, in which a particular person is considered as a subsystem.

Here is how it is written in the Nanjing treatise: "... In spring, the pulse is stringy. In spring, everything is born, u begins to live, at this time young soft branches and leaves appear on the plants, so at this time the pulse wave becomes soft, weak and long. Therefore, they say about him "like a string." If it is not so, a disease will arise. If the pulse in spring is stringy, but full, then a kind person by nature becomes angry, hasty and inattentive, dizzy and ripples appears in his eyes. This means that there is a disease ..." And further: "If in autumn the pulse becomes as it was in spring, it means that there is a disease."

It was written about the pulse in the middle of the first millennium BC. The circle is closed. Ancient becomes modern, and modern surprisingly turns out to be just a repetition of a long-known.

HARDWARE PULSE DIAGNOSTICS RESEARCH OBJECTIVE

As a whole, modern science takes into account only objective facts independent of the observer, which can always be reproduced by reproducing the conditions of observation. In this sense, the traditional eastern manual pulse diagnostics is not a reliable diagnostic method, and the most ardent representatives of scientific medicine often perceive it as quackery. However, the same can be said for any clinical data obtained by the methods of classical medicine – percussion, auscultation, palpation, visual examination. These methods are subjective by definition. But, despite this, it does not occur to anyone to eradicate them from everyday medical practice, and they remain the most important methods for examining a patient by modern clinicians.

In TCM, pulse testing also remains one of the main diagnostic methods, since pulse diagnostics provides practically comprehensive information about the patient's condition. In this case, pulse diagnostics is based on an assessment of the objective physical characteristics of the pulse wave, namely, pressure changes. Therefore, if we move from a subjective assessment of pressure change in the arteries to an objective, device-based one, we may create such a diagnostic system that would satisfy the basic requirements of scientific objectivity. Moreover, ideally, such a diagnostic system would retain the information content of the manual version.

The objective of objectifying essentially subjective manual pulse diagnostics pursued two main goals:

1. To identify objective instrumental characteristics of the pulse, which reflect the physiological state of a person.
2. To create a methodology for interpreting the obtained pulsographic data.

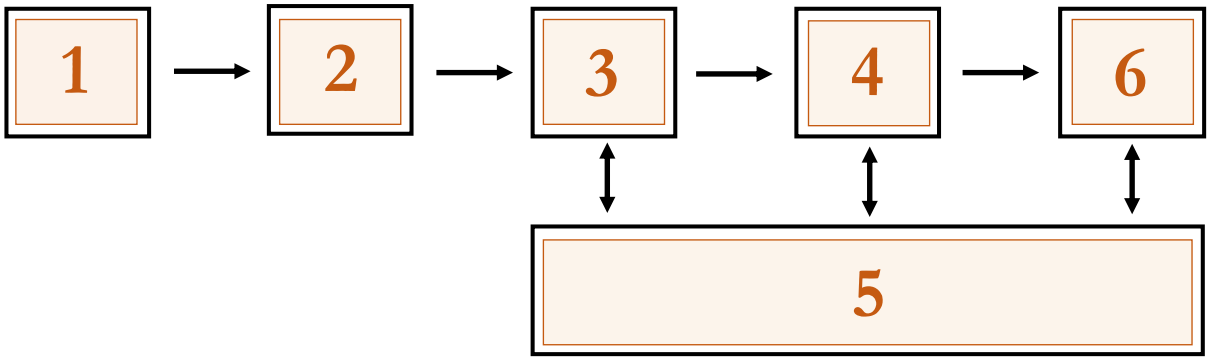
TECHNICAL IMPLEMENTATION OF THE METHOD

From a technical point of view, the proposed technique of device-based pulse diagnostics can be classified as a type of sphygmography. It differs from classical sphygmography in the following:

1. For sphygmograms obtaining 3 points are used on each arm above the radial artery in the distal region of the forearms, known as the classical points of manual pulse diagnostics (Fig. 1).
2. A pre-processed sphygmogram is subjected to a diagnostic evaluation.

In parallel with the development of the method, a series of computer diagnostic complexes were created. At the same time technical problems of choosing the type of sensor and how to fix it over the artery, visualizing the pulse wave, and standardizing equipment and software were solved.

The structural diagram of the device-based pulsodiagnostic complex is shown in Fig. 2.



1. The pulse pressure sensor.
2. Analog filter of pulse wave pressure signal.
3. Programmable gain amplifier.
4. Anapogo-digital converter.
5. The microcontroller.
6. Communication interface with the control computer.

Figure 2

As already mentioned, the most optimal type of sensor for visualizing a pulse wave was an acoustic sensor (microphone) operating in a sealed chamber. The software performs the initial processing of the input signal and visualizes the resulting sphygmogram on the monitor. The sphygmogram processed and displayed on the monitor screen, obtained from one point and at the same pressure, is called a pulsogram (PG). The fixation of 12 pulsograms takes place, which correspond to the pulses of 6 dense and 6 hollow organs. They are recorded in a database of patients and are subsequently available for viewing, comparison in dynamics and printouts.

PULSOGRAPHY METHOD

The study of the pulse is carried out in compliance with the conditions necessary for conducting a manual pulse diagnosis. The patient is in a state of psycho-emotional and physical rest (examination no earlier than 15-20 minutes after any physical activity). The pulse is examined in the sitting position of the patient. His forearms and hands are on a smooth, comfortable surface at heart level. The surface of the palm is facing up, but without muscle tension in the hand and forearm. During the study, the forearms are alternately advanced (first left, then right) to eliminate interference with the free movement of blood.

Doctor takes the pulse sensor like a pencil, finds the first point for a pulse diagnosis from the anatomical landmarks (the cun point on the left hand - Fig. 1) and slightly presses the sensor to the found point. The sensor should be pressed to the pickup point strictly perpendicular to the skin surface. If the point is found correctly, a characteristic curve appears on the monitor screen - a pulsogram, which corresponds to the pulse of a hollow organ. After fixing the pulsogram of a hollow organ in the regime of surface pressure, the doctor gradually increases the pressure at the same point until the radial artery is completely clamped. Then, slowly reducing the pressure on the point, he determines the moment when a characteristic curve appears on the monitor screen. This pupsogram, taken in deep pressure mode, will correspond to the pulse of a dense organ, in this case, the Heart.

All 12 pulsograms are also recorded in the following sequence: the left hand - cun, guan and qi points, then the right hand - cun, guan and qi points. A fixed packet of 12 pulsograms is analyzed by a doctor and stored in a database.

PULSOGRAPHIC COMPLEX STRUCTURE

The pulsogram recorded from one position of the sensor is a series of pulsographic complexes that reflect the heartbeat. And the ***pulsographic complex is, accordingly, a curve that displays one beat of the pulse***. Their number displayed on the monitor screen depends on the heart rate and usually ranges from three to six.

Standard pulsographic complex

In traditional Chinese medicine, the concept of the norm is not metric, that is, it is not based on absolute values and numbers. The concept of the norm in TCM is entirely based on the concept of harmony. Moreover, harmony is understood as a mutual balance and the correspondence of the "internal" to "external" in the broad sense of the word. However, "harmony" is a too broad concept for it to be the basis of device-based or instrumental diagnostics. Therefore, to formulate the technique of device-based pulse diagnostics, we were forced to derive a metric, that is, a measured "norm" of the pulse, examining the pulsograms of healthy individuals in a state of psychological, emotional and physiological peace.

Understanding the whole relativity of the concept of "norm" concerning health, we nevertheless formed the image of an "ideal" pulse and gave the name to this ideal image "standard pulsographic complex" or "standard pulsogram" [23]. We obtained a standard pulsogram by averaging the pulsographic complexes of 237 healthy individuals (117 men and 120 women) aged 18 to 48 years, recorded at different times of the year and day. [12.14]. It consists of a series of ideal (reference) pulsographic complexes that are inherent in an absolutely healthy person (Fig. 3).

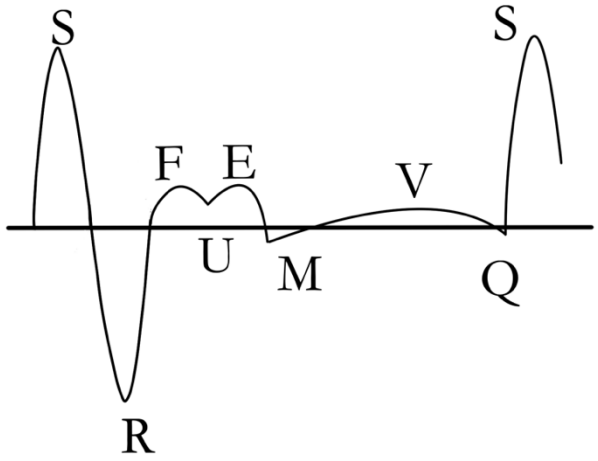


Figure 3

The following deflections are distinguished on the standard pulsographic complex: S, R, F, E, U, M, V, Q. In the direction of the vertices, the deflection can be positive (S, F, E, V) and negative (R, U, M, Q). The maximum in amplitude is the S and R deflection, the longest - the V

deflection. The S and R deflection have sharp peaks, the same width and height. The ratio of the height of these deflections to their width is approximately 3: 1.

Deflection F and E are of smaller amplitude. They are located above the contour, have rounded peaks and are separated by a distinct deflection U. The size of the deflection F and E is either equal in amplitude or the peak of the deflection F is located slightly below the peak E, but not lower than the contour. The deflection V is short and stretched, normally its length is equal to the area occupied by all the other deflections (S, R, F, E, U, M). The deflection V ends with the vertex of the return deflection Q lying on the isoline. The standard pulsographic complex is smooth throughout, it does not have high-frequency oscillations. A standard pulsogram is somewhat a conditional ideal of a pulsogram. In real conditions, in healthy individuals, the proportions of the pulsogram are usually slightly different, while their pulsogram is considered to be normal.

For measuring of the deflection of a real pulsogram, we proposed an individual unit (IU), which is equal to the width of the deflection S of the same pulsogram and relative to which all the sizes of the deflection are determined. Here are the approximate sizes of the teeth of the pulsogram, which is considered to be normal, in Table 2:

Table 3. The dimensions of the deflections of the standard pulsogram

	Determined size	**Maximum, IE**	**Minimum, IE**
S	Height	3,5	2
	Width	1	1
R	Height	3,5	0,6
	Width	1,3	0,8
E	Height	1,3	0,6
	Width	1,3	0,6
U	Height	1,3	0,6
M	Width	4	2,5

In the future, we will see that the basis for making a pulsographic diagnosis is, first of all, the general appearance of the PG or, as we say, the “image”. It is formed primarily by the mutual ratio of the heights and widths of the teeth. Therefore, the absolute size of the deflection is less important than the ratio of the deflection of the pulsogram to each other. In more detail about the "normal" ratios of the deflection, we will describe later in the description of the teeth of the pulsogram.

In the course of the research, we were convinced that, in general, the image of the pulse of both the patient and a healthy person can be stable for days, months, and even several years. This stability, of course, is relative and implies only the general nature of the pulsogram pattern and the average value of the amplitude of the deflections under the same conditions for taking a pulse. In some cases, the pulse is very dynamic and can radically change within a few minutes or

hours. Moreover, noticeable changes in the pulse are affected only by a fundamental change in the functioning mode or restructuring of the activity of the corresponding functional system.

More on this – in the relevant sections. And here we note that the shape and amplitude of the pulsogram of healthy individuals do not directly depend on gender, age and time of day. In general, the amplitude of the pulsogram varies slightly depending on the time of the year - in all leads, it is higher in the summer months and lower in the winter. The dependence of the shape of the pulsographic complex on the current meteorological situation is noted. However, the pulsogram amplitude is larger depending on the functional state of the person - emotional stress or relaxation, the presence or absence of physical activity. Usually, the functional load causes an increase in the amplitude of the pulsogram without changing the basic proportions of the pulsographic complex and resembles scope proportional scaling, but not a simple vertical increase in the size of the deflections.

Studying the conditions of stability or lability of the pulse in healthy and sick, we found out what factors and how can change the pulsogram, as well as what are the functional correspondences of the deflections of the pulsogram.

Marking and interpretation of deflections of a pulse curve

For an accurate interpretation of the pulse curve, preliminary marking of the pulsographic complex with dots-markers is carried out. They allow one to unambiguously identify the deflections and sections of the pulsographic complex, as well as determine the true proportions and ratios of the deflections of the PG, which are the main diagnostic features. Fig. 4 presents two pulsographic complexes - the first, close to the standard, and the second, the pathologically altered version.

The procedure for marking the pulsographic complex is a crucial technological moment, since the localization of 3, 4, 5 M 7 marker points is not always as obvious as on a standard PG. The vertices of the deflections R, F, and U in some cases are smoothed and displaced; additional unstable deflections may appear, as in the second pulse complex (Fig. 4). At the same time, the identification of the shape, amplitude, and ratio of permanent deflections is diagnostically significant. Marking of the pulsographic complex should begin with the identification of the most stable points 1, 2 and 6.

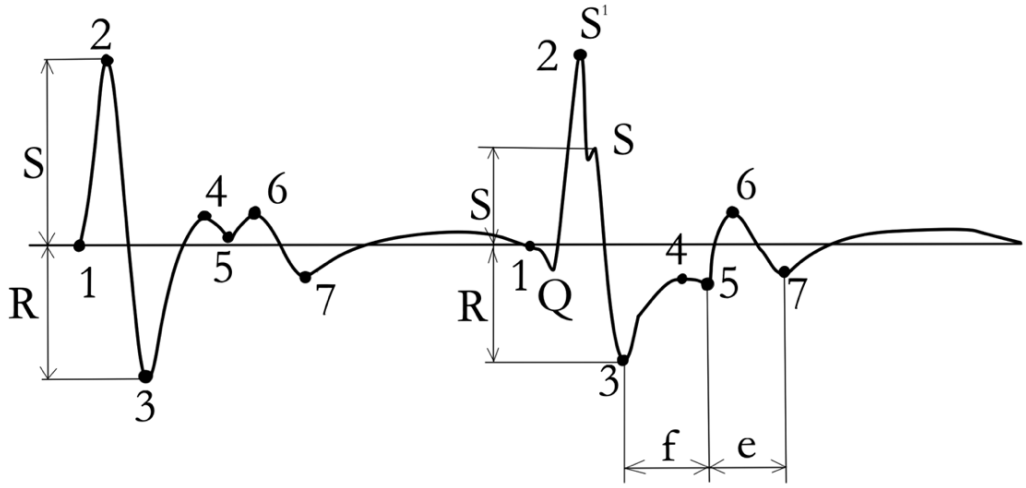


Figure 4

For research and marking, one period of the pulsogram is distinguished, the beginning of which coincides with the beginning of the pulse beat. In most cases, the PG period begins at the beginning of the deflection S and coincides with the apex of the deflection Q. At this point, a point is distinguished — marker 1. However, sometimes the period of the pulsogram begins with a non-constant reverse deflection Q. In such cases, the point marker 1 is installed at the beginning of the deflection Q (beginning of the PG period - see Fig. 4). The contour, concerning which the height of the deflections and their position will be examined in the future, always passes through the marker points of 1 successive pulse complexes.

Point 2 is the highest point of the first positive deflection of the complex and in most cases, it coincides with the peak of deflection S. In case of splitting, point 2 always corresponds to the maximum in the region of the first positive deflection of the complex and can be localized at the top of the unstable pathological deflection S '. In this case, the true peak of the deflection S shifts distally and is not marked with a special point when marking the complex. Point 6 is the highest point of the deflection E, the last "obvious" and most stable deflection of the complex. Points 3, 4 and 5 are marked at the inflection points of the curve of the section between points 2 and 6, taking into account possible typical changes in the deflections. Point 7 corresponds to the lowest point after point 6.

In practice, one has to deal with severe distortions of pulse complexes. This makes it difficult to find point 1 and mark the entire complex. In such cases, one should start from the most stable point 6 and mark the complex in the reverse order, i.e. from the 6th point to the 1st.

Pulsogram deflections

The relative position of the marker points and the intersection points of the contour of the pulsographic curve determines the parameters of the PG deflections. The dimensions of the deflections are determined by the vertical and horizontal distances between the points with markers (Fig. 4).

DEFLECTION S

The top of the deflection S, in the absence of splitting of the first positive deflection of the pulse complex, corresponds to the localization of point 2 (Fig. 4). When the first positive deflection of the PG period splits, the vertex S ceases to correspond to point 2 (see details below). The width of the deflection is equal to the horizontal distance between points 1-3. The height of the deflection is determined by the distance between the top of the deflection and the contour.

DEFLECTION S'

The deflection S' in the pulse complex is usually absent. Its appearance indicates deviations in the functioning of the system. The presence of the deflection S 'can only be said when splitting the first positive deflection of the PG period. In this case, the peak of the deflection S 'coincides with point 2, and the vertex S is considered to be the second peak formed during the splitting of the deflection (Fig. 4, second complex). Depending on the clinical situation, the vertex S can migrate from point 2 to point 3 (the value of the localization level of the vertex S in this section

of the curve will be considered in the following sections). The width of the deflection is determined similarly to the width of the deflection S.

DEFLECTION R

In most cases, this is the largest negative deflection of the PG period. The top of the deflection R always corresponds to point 3. The width of the deflection R is determined by the distance between the points 2-4 horizontally. The normal ratio of the width of S to R is equal to from 1: 1 to 1: 1, 5.

DEFLECTION F

The top of the deflection F always corresponds to point 4; its width is determined by the horizontal distance between points 3 and 5, and its height is determined by the vertical distance between points 4 and 5.

DEFLECTION U

A negative deflection is located between the deflection F and E. The top of the deflection U always corresponds to point 5. Only the depth of the deflection is measured, which is equal to the vertical distance between points 4 and 5, i.e. equal to the height of the deflection F.

DEFLECTION E

The top of the deflection E always corresponds to point 6. The width of the deflection is equal to the horizontal distance between points 5 and 7. The height is equal to the vertical distance between points 5 and 6.

DEFLECTION M

The top of the deflection M always corresponds to point 7. The diagnostic value of the amplitude of the deflection is not defined.

DEFLECTION Q

Normally, the deflection Q is formed by the final part of the deflection V. Its apex is usually located on the isoline and coincides with point 1. Quite rarely, the apex of the deflection Q deepens significantly below the isoline. The diagnostic value of such deviations is not defined.

Pulsographic signs

The actual pulsographic complexes or PG periods of a healthy person can differ markedly from the reference for two main reasons. Firstly, as already mentioned, a healthy person is an abstraction. Secondly, any change in the physiological state of the body, including those associated with functional loads, and not with disease, entails a restructuring of the activity of functional systems about a state of comfortable rest. And this, in turn, leads to a change in the amplitude and / or pattern of the pulsographic complex. The degree of these changes corresponds to the degree of functional shifts in a particular system.

Analysis of a separate PG complex is carried out in three stages. At first stage, the deflections of the complex are evaluated according to the width, amplitude and presence of specific diagnostic signs. At the second stage — identification of diagnostic signs. In the third stage, a synthesis of information and the formation of a conclusion is carried out.

Depending on the features of the functional state of the system under study, various changes in the deflections of the pulsographic complex are possible in comparison with the standard pulsogram. These changes are subject to certain consistent patterns. The most stable is the deflection E, and the most labile - the deflection F. The main value for diagnosis have changes in the shape and proportions of the pulsographic complex, as well as appearance of the splitting of the deflection S and the appearance of high-frequency oscillations on the deflections.

Diagnostically significant changes in the pulsographic complex are called diagnostic pulsographic signs. They are divided into main and confirming, i.e. those that do not have independent significance. The main ones are signs that are reflected in the general figure of the PG. This is manifested in:

- decreasing or increasing in the amplitude of the deflections;
- increasing or decreasing the width of the deflections;
- changing in the position of the deflections relative to the contour and each other;
- the appearance of additional (pathological) deflections;
- the occurrence of high-frequency oscillations against the background of the main deflections.

The presence of two or three main PG signs allows one to reliably evaluate the function of the investigated organ. The repetition of the same basic signs in different leads indicates the same type of systemic changes in the group of organs.

Confirming PG signs do not have independent significance, but significantly increase the diagnostic significance of the main ones. Their common distinguishing feature is the repeated homogeneous distortions of the GHG curve, which do not significantly affect the overall proportions of the pulse complex. They appear:

- in the region of the deflection R - by the formation of characteristic fractures on the descending and ascending sides of the deflection;
- in the area of the deflection F and E - by shifting their vertices to the right or left and / or by sharpening them;
- in the area of any deflection - “cutting” of its top.

When analyzing all PG signs, it should be remembered that the real current functional state of the system is reflected only by regularly repeating (!) signs on the PG recorded in a state of relative general functional rest. Below are the most common deflections changes. However, the whole gamut of possible changes in the deflections of the pulsogram is not limited to them.

CHARACTERISTIC CHANGE OF THE DEFLECTION S:

- increase in amplitude (Fig. 5, a);
- the decrease in amplitude with preservation of width (Fig. 5, b, c);
- relative reduction of the width and pointedness of the apex ("awl-shaped S") (Fig. 5, d);
- bifurcation of the deflection (the appearance of the sign S') (Fig. 5, d — f).

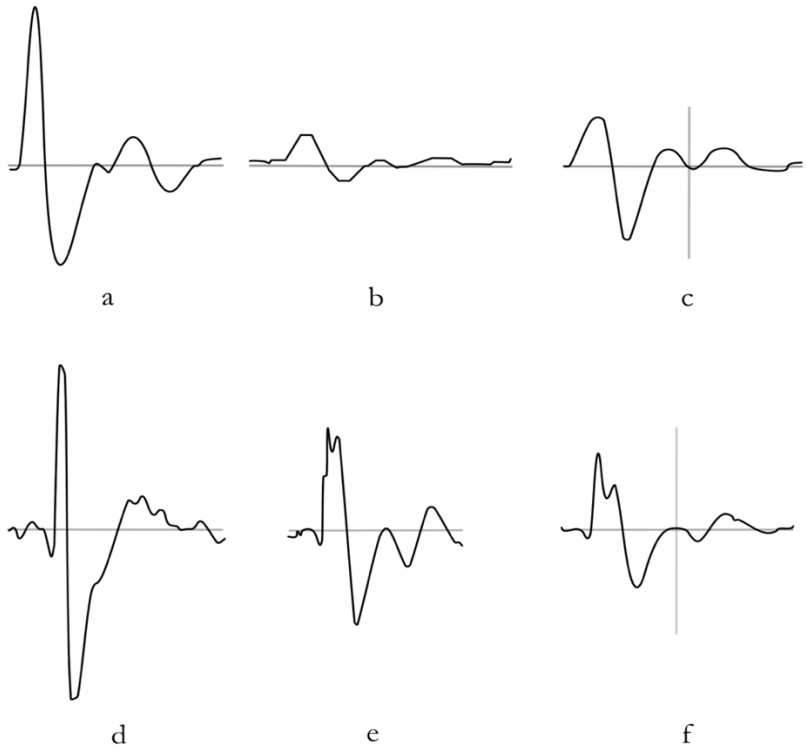


Figure 5

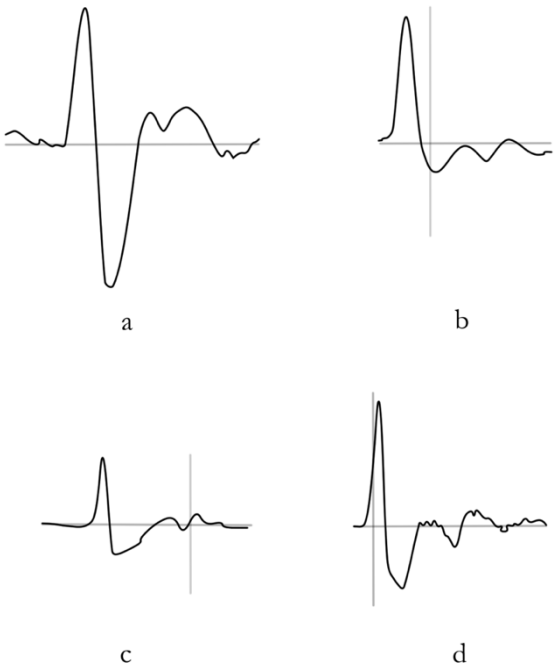


Figure 6

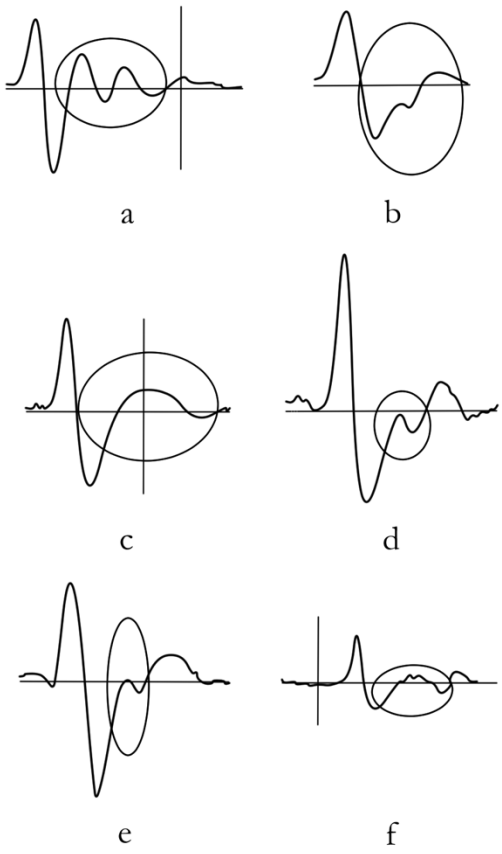


Figure 7

CHARACTERISTIC CHANGE OF THE DEFLECTION R:

- the amplitude of the deflection R exceeds the amplitude of the deflection S (Fig. 6, a);
- decreasing in amplitude (Fig. 6, b);
- deflection expansion (Fig. 6, c);
- formation of a kink at the apex on the descending part of the deflection R (Fig. 6, d);
- formation of a fracture on the ascending part of the deflection (Fig. 6, c).

CHARACTERISTIC CHANGE OF THE DEFLECTION F:

- increase in amplitude - the peak is higher than the peak of the deflection E (Fig. 7, a);
- deflection F is located below the contour (Fig. 7, b);
- deflection F merges with deflection E (Fig. 7, c);
- pointing of the top (Fig. 7, d);
- narrowing of the deflection (Fig. 7, e);
- deflection expansion (Fig. 7, f).

CHARACTERISTIC CHANGE OF THE DEFLECTION E:

- pointing of the top (Fig. 8, a);
- deflection expansion (Fig. 8, b).

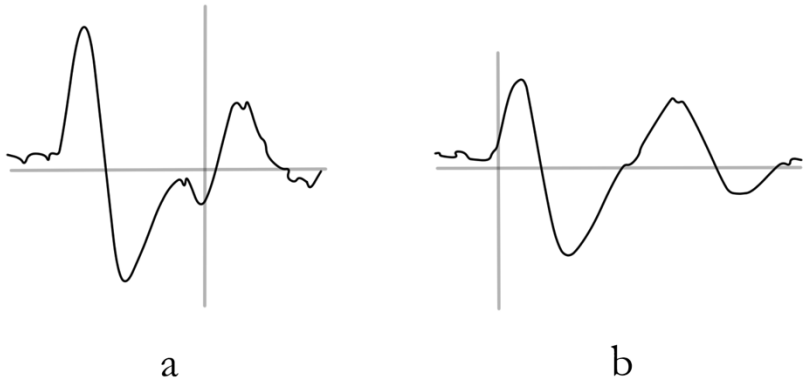


Figure 8

CHARACTERISTIC CHANGE OF THE DEFLECTION U:

- increase in the amplitude of the deflection (Fig. 9, a);
- decrease in amplitude or complete absence of a deflection (Fig. 9.6).

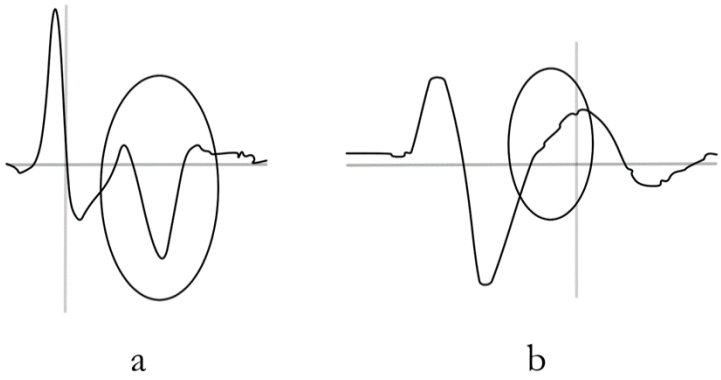


Figure 9

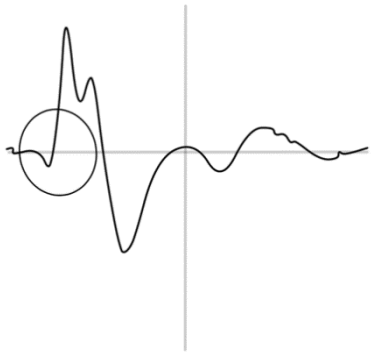


Figure 10

CHARACTERISTIC CHANGE OF THE DEFLECTION Q:

- deflection Q below the contour (Fig. 10).

PULSOGRAM DECODING METHODS

When creating the methodology for interpreting the pulsogram, the authors proceeded from the fact that:

- pulse diagnosis is primarily a method of oriental medicine, therefore, when decoding pulsograms, one should start from the eastern (in particular from the Chinese traditional pulse) diagnosis;
- classic points for pulse diagnostics reflect the state of six dense and six hollow organs, considered in traditional Chinese medicine;
- despite the lack of direct correspondences between the terminology of Chinese and modern medicine, the pulse at the classical points of pulse diagnostics allows us to judge the work of internal organs and the modern doctor.

For readers who are not familiar with traditional Chinese medicine, a brief excursion into the traditional "Chinese" physiology is necessary. It is believed that there are six major organs, called dense, and six secondary or hollow organs in the body. Dense organs include the Heart, Pericardium, the Spleen + Pancreas complex, Lungs, Kidneys, and Liver. Hollow organs include Small intestine, Triple heater, Stomach, Large Intestine, Bladder, and Gall bladder. According to the functions performed, each dense organ has a pair – a hollow organ. Such a union (dense — hollow organ) refers to one of the five primary elements of the U — Sin cycle, known from Chinese philosophy:

The primary element **Earth** includes the Spleen + Pancreas and Stomach

to the primary element **Metal** – Lungs and Large intestine

to the primary element **Water** – Kidneys and Bladder

to the primary element **Tree** – Liver and Gall bladder

the primary element **Fire** includes two pairs – Heart and Small intestine, as well as the Triple heater and Pericardium

Each pair of organs has its representative in the Cun-Kou region, i.e. on the wrist, in the place of feeling the pulse (see Table 1).

It is important to note that all of the above bodies are hereinafter considered as they are commonly understood in TCM. Namely, behind each name there is no anatomical education, but a certain functional system that performs a very specific set of functions. And only secondly several tissues and anatomical formations may be referred to this or that organ. A description of the correspondence of organs, functions and anatomical formations according to the Chinese tradition is given in the Table 3.

Table 4. Functions corresponding to organ associations according to TCM

 Fire	Heart	Face, blood vessels, blood, tongue, heart	Repository and creation of general Shen, control of consciousness, blood circulation, sweating
	Small intestine	Small intestine	Separation of clean and cloudy fluids, transfer of "clean" to the spleen, "cloudy" - to the large intestine, fluid - to the bladder. Reply from the Heart of Fire and Slime
	Pericardium	No anatomical formation	"Protection" of the heart, blood circulation
	Triple heater	No anatomical formation	Control of evaporation, permeability of hollow organs, digestion and circulation of fluids
 Earth	Spleen	Spleen, pancreas, connective tissue, ligaments, muscles, lips	The conversion of nutrient and moisture; transportation of nutrient and moisture; lift function; body fluid regulation; blood control; responsibility for muscles and limbs; sense of taste
	Stomach	Stomach	Intake and digestion of food, the formation of nutrient fluid, nutritional energy and substance
 Metal	Lungs	Lungs, larynx, nose, skin, skin hair	Monitoring and regulation of total Qi, skin and pore conditions, sweating, body temperature, limb activity, smell, respiration; expansion and cleaning downward drainage, clarification of liquids
	Colon	Colon	Separation of the necessary from the unnecessary, transport and secretion

 Water	Kidneys	Kidneys, spinal cord and brain, bone marrow, teeth, inner and outer ear, hair on the head, internal genital organs, urethra and anus	Accumulation of substance, accumulation and distribution of total Yin, reproductive function, ensuring growth and development, reproduction of blood, water management, Qi intake, growth and strength of bones, teeth, hair, ensuring the formation and functioning of the brain, heating and activating the function of organs
	Bladder	Urinary tract	Accumulation, exchange of body fluids, their evaporation and the formation of urine
 Wood	Liver	Liver, eyes, external genitalia, nails	Accumulation and regulation of blood, transportation and excretion, participation in digestion by supporting Qi of the Stomach, Spleen, Gall Bladder; support for the operation of a Triple Heater to ensure water permeability; responsibility for visual acuity, clarity of vision and color perception
	Gall bladder	Gall bladder	Education, accumulation and excretion of bile, effect on mental activity

From the table 3 it can be seen that the functions of the hollow organs are generally transport and cumulative, i. e. auxiliary character. The functions of the dense organs have deeper meaning, corresponding to those primary elements to which these organs belong. Actually, according to this principle, the organs are correlated with the primary elements of U — Sin.

Note. It is fundamentally important that with the help of pulse diagnostics in TCM, the state of precisely the organs, rather than their channels, is assessed. Therefore, one should not look for direct coincidences, for example, with the clinical description of canal pathology syndromes cited in the literature on classical acupuncture. This is especially important to emphasize, because among doctors, and even more so among patients, Chinese medicine is mainly strongly associated exclusively with acupuncture and canals (meridians).

Thus, evaluating the state of the Liver by pulse, we can judge the state of the Liver itself, ligaments, tendons, peripheral nerves, Eyes, and the numerous functions performed by all these organs. If pathological signs are revealed on the pulsogram of any organ, then we can confidently say that there are deviations in the functioning of this organ. But since an organ in traditional

Chinese medicine is a complex of organs and tissues that are united by common functions, that is, form a single functional system, pulse diagnostics make it possible to judge the state of the functional system as a whole. First of all, the state of the function is reflected on the pulsogram, and only secondarily, indirectly, can we judge the morphological state of the corresponding organs and tissues, without direct indications of the localization of the process.

> **Note.** In other words, like manual pulse diagnostics, the device-based version provides information about the state of the "Chinese organ" as a whole. Determine the localization of the pathological process helps other types of clinical diagnosis, for example, a survey or examination.

Depending on the task, the analysis of the pulsogram can be carried out in two ways:

1. Analysis in terms of traditional Chinese medicine with access to a syndromic Chinese diagnosis;
2. A functional assessment of the state of the main organs and systems.

The latter method is more suitable for doctors who are not familiar with TCM. But both methods of analysis include the following steps:

1. Marking of pulsographic complexes and determination of teeth of each of 12 pulsograms.
2. Analysis of the pulsogram of each organ.
3. The formation of a diagnostic report.

PULSOGRAM ANALYSIS IN TERMS OF TRADITIONAL CHINESE MEDICINE

Device–based pulse diagnostics today is the only instrumental method that allows one to objectively confirm or refute the clinical diagnosis made in terms of TCM. Unlike other instrumental methods that are used for diagnostic purposes in alternative, complementary medicine, HPD based on objective criteria allows us to judge, firstly, the state of the "Chinese" organs, and not the channels. And secondly, do it according to classical canons (according to eight guidelines).

> **Note.** Various diagnostic options for Hakatani, Akabane provide information about state of the main meridians and only indirectly allow us to talk about the state of activation (Heat syndrome) or insufficiency of a Cold syndrome) of the main organs.

For a novice doctor working in the framework of TCM, pulse diagnostics can be a "teacher" who confirms the correct diagnostic judgment and does not allow to make a diagnostic error. For a doctor with experience in traditional Chinese medicine, the HPD provides additional objective information that can be crucial in making a diagnosis and prescribing treatment. Also, HPD is indispensable in diagnostically complex cases, with mixed syndromes, and especially for diagnosing the condition of patients with chronic and combined pathology. Examples of this use of the HPD are given in the chapter "The practice of device-based pulse diagnostics".

Analysis of pulsographic signs

The severity of pulsographic signs may be different. But there is one general rule: the more pronounced pathological changes in the pulsogram are the more pronounced the patient's syndrome is. Diagnostically significant are only signs or images that are regularly repeated in different pulse complexes.

Considering the pulsographic complex as a "functional scan" of the activities of the "Chinese" organ, we have identified sections of the pulsogram that correspond to concepts such as Yang, Yin, Qi and the substance of the organ. Recall again that here we are talking about understanding the body within the framework of TCM. Our studies showed that the area between points 1-3 corresponds to the organ Yang (Fig. 4), the region between points 3 and 4 corresponds to the organ Yin, and the region from point 4 to point 7 reflects the state of the substance (Chin) of the organ. Accordingly, changes in each of the sections of the pulsogram indicate the corresponding changes in the work of the body. At the same time, the general principles of changing the pulsographic complex must be taken into account: an increase in the length of the site or amplitude of the tooth always unambiguously indicates an increase in the weight of the corresponding functional component in the overall balance of the organ energies. The converse is also true - a decrease in the tooth and / or a shortening of the portion of the pulsogram indicates a decrease in the proportion of the corresponding component.

For example, an increase in the amplitude and width of the S wave of the pulsogram indicates an increase in the organ's Yang and a tendency to Heat or Fire syndrome. A decrease in this deflection (compared with the normative pulsogram) indicates a lack of organ Yang and, therefore, a tendency to Cold syndrome. The expansion of the site 3-5 to sizes more than normal, indicates an excess of Yin and a tendency to Humidity syndrome.

In practice, the analysis of the pulsogram as a whole is carried out either by the algorithm of sequential detection of pulsographic signs or by the method of recognition of images of "pathological" pulsograms (images of pulsograms corresponding to a particular syndrome).

Let's start with the first method. From the 3–6 complexes recorded on the screen, the doctor selects the most typical complex for this organ and evaluates it according to the following algorithm:

1. First, the amplitude of all the teeth is evaluated, thereby diagnosing the Cold or Heat syndrome by the main signs. Then confirming signs of Cold or Heat syndromes are identified and summarized.
2. At the second stage, signs of the presence of Humidity or Dryness syndromes are determined by the main and confirming signs.
3. In the third stage, the presence of Wind syndrome is determined.
4. Next, the presence of the Emptiness or Fullness of the organ is determined.

Similarly, conclusions are made in terms of TCM for each of the six dense and six hollow organs. After that, the doctor proceeds to the formation of the conclusion.

When examining pulsograms in this way, it is important to identify the main signs of pathology and, depending on this, interpret the rest, as a rule, that does not have independent significance. The main diagnostically significant patterns are given below in the table 4. We divided the diagnostically significant pulsographic signs into main and confirming ones there. Decryption is carried out according to the presence of primarily basic pulsographic signs. Confirming signs are

a valuable diagnostic tool when they are logically consistent with the main diagnostic signs. The contradiction between the main and supporting signs does not refute the first, but it forces a closer look at the pulsogram and compares it with the clinical picture. The independent value of the supporting signs, i.e. without basic ones, significantly less, because often on the pulse complex, they may be absent altogether.

Table 5. Pulsographic signs in terms of TCM

PG deflection	Diagnostic signs	TMC syndrome	Sign category	Figure
S	Decreasing in amplitude	Cold	Main	Fig. 14
	Increasing the amplitude	Heat, Fire	Main	Fig. 11 - 13
	Relative reduction of the width ("awl-shaped S")	Emptiness	Main	Fig. 5a, 5d, 13
	Bifurcation of the deflection (the appearance of the sign S ')	Emptiness	Main	Fig. 5e, 5f
R	Decreasing in amplitude	Emptiness	Main	Fig. 6b, 6c, 6d
	The amplitude of the deflection R exceeds the amplitude of the deflection S	Emptiness	Main	Fig. 6a
	Decreasing of amplitude and expansion	Emptiness	Main	Fig. 6b, 6c
	Formation of a kink at the apex on the descending part of the deflection R	Emptiness	Confirmed	Fig. 6d
	Formation of a fracture on the ascending part of the deflection R	Cold, Humidity	Confirmed	Fig. 6c
F	Increase in amplitude (the peak is higher than the peak of the deflection E)	Energy block or Completeness syndrome	Main	Fig. 7a
	Deflection F is located below the contour	Emptiness	Main	Fig. 7b, 7c
	Deflection F merges with deflection E	Cold	Main	Fig. 7c
	Pointing of the top	Heat	Confirmed	Fig. 7a, 7d
	Vertex shift to the left	Heat	Confirmed	Fig. 7a, 18
	Vertex shift to the right	Humidity	Confirmed	Fig. 6c
	Narrowing of the deflection	Dry	Main	Fig. 7d, 7e, 20
	Deflection expansion	Humidity	Main	Fig. 7f, 18, 19

E	Pointing of the top	Heat	Confirmed	Fig. 8a
	Deflection expansion	Heat	Main	Fig. 8a, 8b
U	Increase in the amplitude of the deflection	Cold	Main	Fig. 8b, 9b, 21
	Decrease in amplitude or complete absence of a deflection	Heat	Main	Fig. 9a
Q	Deflection Q below the contour	Abnormality of Shen	–	Fig. 10
High–frequency oscillations on any tooth		Wind	Main	Fig. 22
"Cutting off" the top of any deflection		Emptiness, Cold, Wind, abnormality of Shen	Confirmed	Fig. 22

The second method of analysis is based on the figurative perception of the pulsogram. Each Chinese syndrome has its specific clinical image, which an experienced doctor distinguishes quite easily and quickly. Similarly, an experienced HPD user recognizes the pulsographic image of the Chinese syndrome almost instantly, without lengthy "on-screen computing". Of course, these images in each patient always have an individual specificity, but in general, they are always easily recognizable. Their most common features are presented in the table 5.

Table 6. Pulsographic images of TCM syndromes

Syndrome	Pulsographic image
Fire	High, well-drawn large deflections of the pulsographic complex (the pulsogram is close to the norm, but uniformly stretched in amplitude). The deflection pattern is usually smooth.
Heat	1. The same as that of Fire, but of a smaller amplitude with clearly formed sharpened peaks of the deflections, sometimes in the form of "crests". Overlays of other "modifying" syndromes (Dryness, Humidity, Wind) are visible. 2. In some cases, the total amplitude of the teeth is small except for the deflection U, extended down ± the sharp tips of the deflections F and E ± signs of the syndromes of Dryness, Humidity, Wind.
Cold	Reducing the amplitude of all the deflections and / or smoothing the boundaries between the deflections F and E. The complex is wide and flat. Often visible overlays of other "modifying" syndromes of Humidity, Wind, Dryness.

Dampness	Modifies the main syndrome, expanding first the deflection R, and then F. It does not affect the amplitude of the deflections and the entire complex.
Dry	Modifies the main syndrome, causing a narrowing of the deflection F. In future, the amplitude of the deflection R ± may decrease, and the entire pulse complex can be compressed (in length). The amplitude of the deflections and the entire complex is very slightly affected.
Wind	It brings a high-frequency "bounce" into the deflection pattern of the pulsogram (not to be confused with the artifacts of the pulse taking!), Up to the indistinguishability of individual deflections. The second option is horizontal cutting of the deflections.
Emptiness	The most characteristic is the small-scale (especially negative deflections) pulse complex with a clearly split or "awl-shaped" first deflection and a low- amplitude but widely deployed deflection R. Often this is combined with the next deflection R dropped down below the isoline.
Completeness syndrome	The 1st option is similar to the picture of Fire - the "normal" pulsogram significantly increased in amplitude. It is characteristic for the completeness of defensive forces. The 2nd option is an asymmetric increase in the amplitude and width of deflection R (it is visually larger than deflection S) and / or an increase in deflection F (it is wider and higher than deflection E). Option speaks of the completeness of the pathogenic factor.

The practice of doctors-users of the method shows that both approaches have the right to life and give equivalent results, and an experienced HPD user sooner or later comes to a combination of the two approaches in the analysis of pulsograms. The choice of analysis method depends only on the personal preferences of the doctor.

Pulsographic Images of TCM Syndromes

Syndromes of Heat and Fire

Conditions related to one type of physiological reaction of a functional system and/or organ (tissue). From the point of view of etiopathogenesis and clinic syndromes have fundamental differences, however, they are very close in their pathophysiological characteristics. They are characterized by hyperfunction, increased blood circulation and tissue metabolism with a predominance of catabolic processes, so they look identical in pulsography.

The main pulsographic signs of Heat and Fire in order of increasing significance of the sign:

1. Increasing the amplitude of the deflection S or S '(if any).
2. The increase in the amplitude of the deflection U, and therefore, the height of the deflections F and E.
3. An increase in the amplitude of the deflection S and R simultaneously.
4. The formation of the "subulate" S.

Confirming pulsographic signs for Heat and Fire syndromes:

1. The fracture on the descending part of the deflection R.
2. The sharpening of the apex of the deflection F.
3. The sharpening of the top of the deflection E.

For the diagnosis of Fire or Heat, it is not necessary to have all of these signs at the same time, 1- 2 basic signs are enough. In general, the severity of the Heat (Fire) syndrome is primarily indicated by the degree of increase in the amplitude of the deflection S and / or U relative to the norm - the higher the amplitude, the more pronounced the syndrome. The Syndrome of Fire of Completeness is diagnosed when the total amplitude of the pulsographic complex is greater than the normative and there is no sign of “styloid S” or S’ (Fig. 11). In addition, a deep deflection U can be noted in combination with confirming signs of sharpening of the peaks of the deflection F and E; a shift of the top of the deflection F to the left is possible.

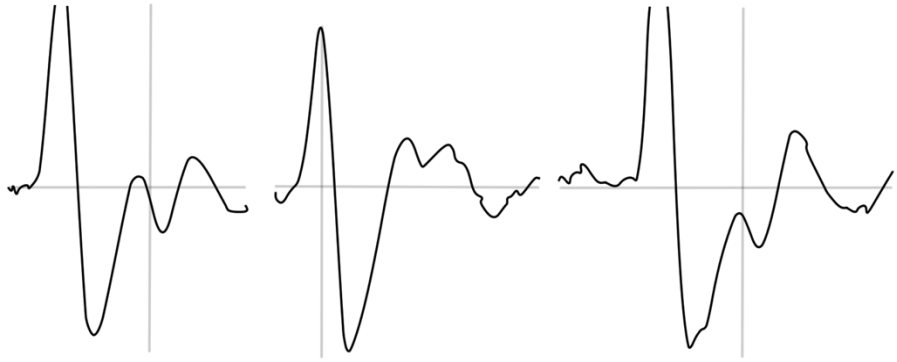


Figure 11

An identical pulsographic picture is also characteristic for Heat syndrome, but with a low amplitude of the deflection S (Fig. 12).

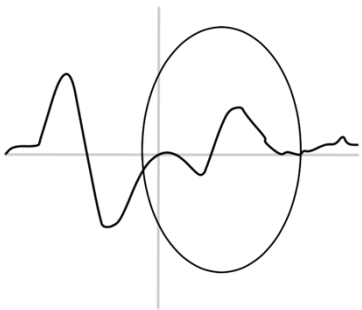


Figure 12

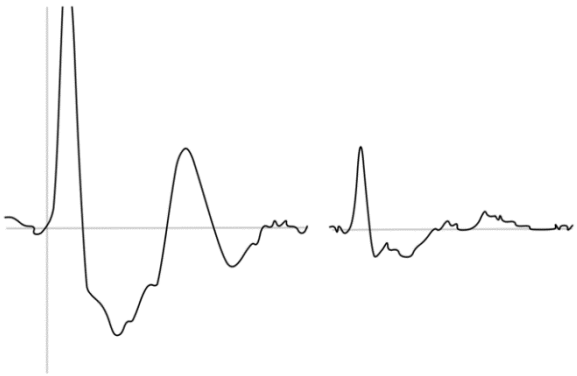


Figure 13

The main sign of "subulate S" is specific not only for the pulsographic syndrome Heat (Fire) but for the Emptiness syndrome. However, the "awl-shaped S" even with a low amplitude of the first positive tooth indicates a combined syndrome of Heat (Fire) and Emptiness. Its amplitude reflects the severity of the symptoms of Heat (Fire), combined with the symptoms of the Emptiness: the higher the "awl-shaped S", the more pronounced the Heat syndrome. With a low amplitude, they speak of a combination of the Emptiness and Heat syndrome, with a high amplitude - the Emptiness Fire. Also, the Emptiness and Heat syndrome is determined when the total amplitude of the pulsographic complex or only the S wave is less than the norm, but there are other main and / or confirming signs of Heat (Fig. 13).

Cold Syndrome

It looks like the antipode of the Heat syndrome not only clinically, but also on the pulsogram. It is characteristic for Cold syndrome:

1. The decrease in the overall amplitude of the pulsographic complex.
2. The decrease in the amplitude of the deflection S.
3. The decrease in the total value of the deflections S and R.
4. Reduction or disappearance of the deflection U (deflection F merges with deflection E).

Confirming signs are:

1. The formation of a fracture on the ascending part of the deflection R.
2. The displacement of the top of the deflection F to the right.
3. Horizontal "cut" on any deflection

Depending on the pathogenesis of the disease and its duration, one or all of the main symptoms can be detected at once, combined with supporting signs. The severity of Cold syndrome is proportional to the decrease in the amplitude of the teeth and the number of pulsographic signs found on the pulsogram (Fig. 14).

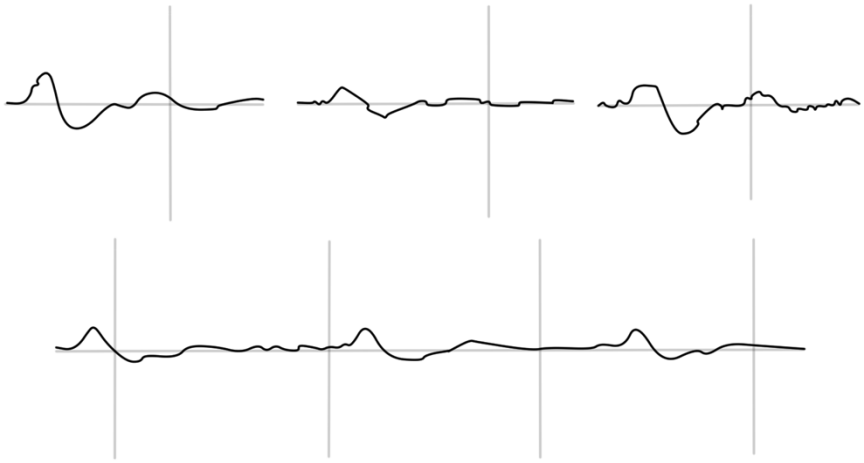


Figure 14

Severe and prolonged Cold syndrome according to the guidelines of TCM can be attributed to K Emptiness syndrome (see below). However, an acute and severe Cold is usually clinically accompanied by signs of the Fire of Completeness (an acute disease caused by a pathogenic factor of external Cold), which is also reflected in the pulsogram by an increase in the total amplitude of the pulse complexes. Sometimes in such cases, you can see a combination of pulsographic signs of Fire and Cold – against the background of high-amplitude deflections S, U and F, repeated smoothed deflections U co merge with deflections F and E into a single conglomerate (Fig. 15).

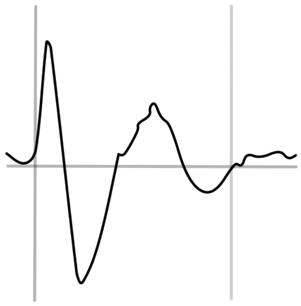


Figure 15

Completeness Syndrome

This is a clinical manifestation of active opposition to the body's defenses and a pathogenic agent proceeding in the form of a disease. The main pulsographic signs of completeness of protective forces (the 1st variant of the syndrome of completeness) are the high total amplitude of the deflections S and R + high deflections F and E. This corresponds to the standard pulsographic picture of the Fire of Completeness (Fig. 11). With the so-called blocking of the organ by a powerful pathogenic factor, mucus, fluid, etc. is accumulated. In such cases, we are talking about the accumulation of a pathogenic agent (the 2nd variant of the syndrome of Completeness). In this case, the following symptoms are revealed on the pulsogram: the amplitude of the deflection R exceeds the amplitude S + of the deflection F above the deflections E +/- in combination with the expansion of the area between points 3-5. The total amplitude of the pulse complex can be both high (Fig. 16, a) and low (Fig. 16, b).

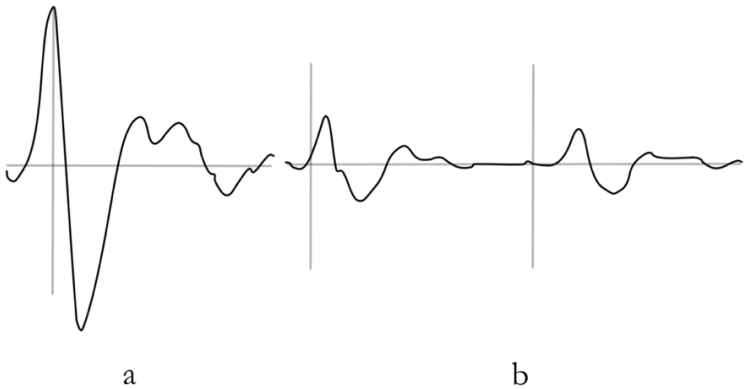


Figure 16

So, for the syndrome of Completeness, there are no confirming pulsographic signs. The standard pulsographic picture of the Fire of Completeness (Fig. 11) is more specific for the syndrome of Completeness of the defensive forces, and the options for the Completeness shown in Fig. 16 a — b — for the completeness of the pathogenic factor.

Emptiness Syndrome

It always indicates a decrease in reactivity and resistance reserves, i.e. decreased effective performance and overall resistance to pathogenic factors. It is characterized by the following main pulsographic signs:

1. Bifurcation of the deflection S (the appearance of the S sign's of varying severity).
2. "Awl-shaped" deflection S (as an extreme manifestation of the sign S').
3. The decrease in the amplitude of the R wave.
4. The extension of the deflection R.
5. The top of the deflection F is located below the contour.

Confirming pulsographic signs:

1. Kink on the deflection R (Ha of the descending and / or ascending part of it).
2. "Cut" the top of any deflection.
3. High-frequency oscillations on any deflection.

The amplitude of the deflections for the diagnosis of Emptiness syndrome is not important, since the amplitude of the deflections more reflects the level of functional activity than the reserves of resistance. However, with a low amplitude of the pulse complex as a whole, one can speak of a more pronounced Emptiness (Fig. 17).

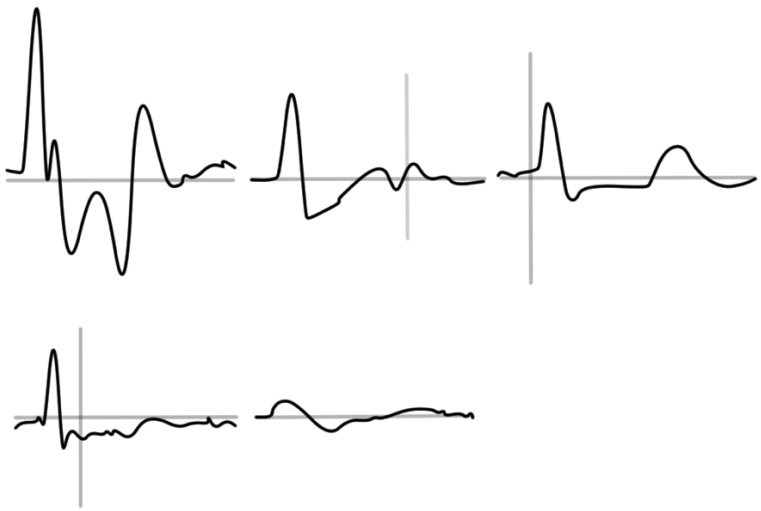


Figure 17

Dampness Syndrome

It has one main feature: the expansion of the deflection F or, more precisely, the distance between points 3 and 5. The confirmation signs of Humidity include: the formation of a fracture on the ascending part of the deflection R and the displacement of the apex of the deflection F to the right. Clinically isolated Humidity syndrome is rare. And significantly more often - in the form of combined syndromes Wet Heat (Fig. 18) or Wet Cold (Fig. 19). This is also confirmed by the practice of device-based pulse diagnostics: signs of Humidity syndrome are most often manifested in combination with pulsographic signs of Heat or Cold syndromes.

Figure 18

Figure 19

Dry syndrome

It manifests itself as a narrowing of the F wave (plot 3-5 of the pulsographic complex). This syndrome also occurs much more often in combination with Heat and Cold syndromes - Dry Heat (Fig. 20) and Dry Cold. However, Dry Cold tends to "fire", therefore, in its pure form is rare. More often it can be found in the form of a pulsographic Popnota Fire with a smoothed deflection U and a narrow deflection F (Fig. 21).

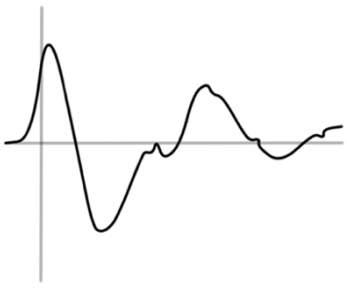


Figure 20

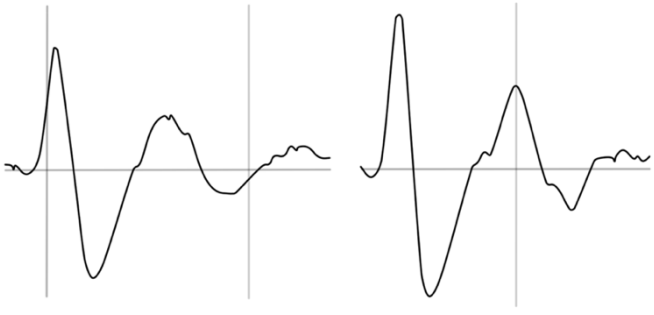


Figure 21

Wind Syndrome

It is characterized by persistently repeating random high-frequency oscillations on any deflection (mainly in the region of the V hill) or in general on the pulsographic complex. Moreover, these oscillations can be both insignificant in amplitude and comparable in scope to the pulses of the pulsogram, up to a complete distortion of the pulsogram pattern. The second main sign of the Wind is a horizontal section of the top of any deflection of the pulsogram (Fig. 22).

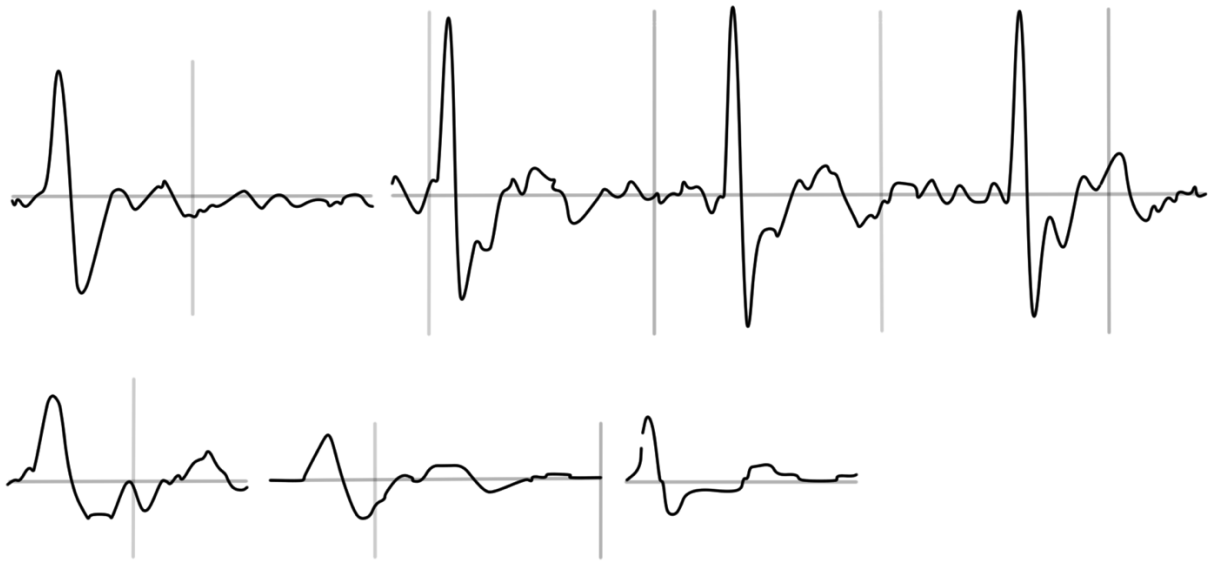


Figure 22

Final diagnostic conclusion in terms of TCM

The diagnostic conclusion of HPD alone mustn't be a definitive diagnosis. It, like the data of any laboratory and device-based methods in modern medicine, helps to substantiate the diagnosis of a doctor.

On the other hand, when forming a diagnostic report, any functionalist doctor certainly compares the device-based data with the clinical and preliminary diagnosis. This rule of forming a conclusion is also true for the ADF method. Each specialist who works with device-based pulse diagnostics develops his algorithm for generating a conclusion, reflecting the characteristics of the doctor's clinical thinking and his working conditions (general practice, taking a "narrow" specialist, sports medicine, psychosomatics, etc.). But starting doctors in the early stages can use the following indicative procedure for forming a conclusion.

So, having an assessment of the condition (in terms of TCM) of all 12 organs, the first step is to determine whether the revealed changes in the function are of a system-wide (predominant) nature. If so, then the second step is to evaluate whether the external or internal pathogenic factor causes these changes. Often changes are observed only on pulsograms of hollow organs. In this case, the conclusion is made that the pathogenic factor has an external origin. If the most significant changes in the pulsogram are observed in dense organs, then the pathogenic factor is internal. If the pulsograms of both hollow and dense organs are systematically changed, we are

talking about a long-existing general syndrome with deep penetration of an external pathogenic factor or a chronic disease associated with an internal pathogenic factor.

Consideration of the clinical picture of the disease is mandatory because there are situations where the above rule does not work. For example, there are systemic changes in GHG in the absence of an obvious clinical picture. In such cases, we can talk about the features of the background state of health with one or another leading syndrome. This syndrome reflects the specific focus of metabolic processes, functioning, and general physiological processes. In this case, a special task is to identify the primary source of the pathogenic factor. To solve this problem, it is important to pay attention first of all to the anamnesis, clinical picture and the degree of severity of the change in the pulsogram in the dense organs typical for this pathogenic factor. Such patients may not present any specific complaints.

If, in the presence of a clinical picture — complaints, anamnesis, objective symptoms — there are no systemic changes in the pulsograms, but there are local changes in one to three leads, then the existing symptoms can be associated with damage to the corresponding organs. The pulsograms of these Chinese organs seem to be "knocked out" of the overall picture. The same rule works here: if pathological changes are found on the pulsogram of a hollow organ, the external syndrome of this organ is diagnosed, if vice versa, then the internal one. In most cases, significant changes concern not one pair of organs, but no less than two or three. In such a situation, it is necessary to make a diagnosis for each pair, and then “collect” the pulsographic picture in the form of a traditional diagnosis, indicating typical causal relationships of the development of the pathological process. Here again, the clinical picture of the disease begins to play a significant role. The organs that play a leading role in the patient’s current state are determined by clinical, pulsographic data and using the Yin-Yang and U-Sin models known from TCM.

When assessing the pulsograms of paired organs, it should be remembered that the condition of a dense organ is more important clinically and prognostically for a pulsodiagnostist, and the role of Yin in a dense-hollow organ is assigned to the dense organ and Yang to the hollow. Therefore, in some cases, the pulse of a hollow organ can be considered as Yang of a dense organ paired to it. Taking this point into account will help to avoid many diagnostic errors. For example, immediately after eating, the high amplitude of the Stomach pulse in combination with the noticeably “colder” Spleen pulse should not be evaluated as the Stomach Fire against the background of the Spleen Cold. Most likely, here the high pulse amplitude of the hollow organ is associated not with the presence of an external pathogenic factor affecting the Stomach, but with its high functional activity at the moment (digestion of food). This clinical version should be confirmed by the absence of appropriate complaints.

An independent diagnostic value is the high amplitude of the pulse of a hollow organ can only have a deliberate absence of increased functional load on it. In combination with distortion of the shape and proportions of the pulses of the pulsogram, this becomes clinically even more significant. Persistent changes in the amplitude and shape of the teeth of the pulsograms of dense organs should be much warier of the doctor, depending on little on the load. Such changes in the pulsogram, even in combination with micro-symptoms, give reason to say that the patient has one or another syndrome.

DEVICE-BASED PULSE DIAGNOSTICS AS A FUNCTIONAL DIAGNOSTIC METHOD

Theoretical background

The traditional Chinese diagnosis is formulated according to the same principles as the diagnosis in classical Western medicine. In a generalized form, the diagnosis consists of two parts: in the first part, the name of the disease (or pathological change) is indicated; in the second - the organ or system where the pathology develops. But with all the external similarity of the diagnostic constructs, direct nosological comparisons between the Chinese syndromic and modern classical diagnosis are more often impossible. The main problems of mutual integration lie in the following.

Firstly, the **nosological part** of the Chinese diagnosis mainly reflects the "direction" of the development of the pathological process, but not the results of these processes in the form of morphological changes in the tissues of organs, which modern medicine seeks to identify in the first place. And although changes in structure and function are, of course, related, they are far from always being recorded simultaneously. For example, there are already characteristic dysfunctions of the function (metabolism) in the tissues, but there is no tumor yet.

Secondly, the understanding of the localization of the disease in modern and Chinese medicine is very different. As already mentioned above, the "Chinese" organ is a much broader concept than the anatomical organ in the modern sense. Therefore, the **topical part** of the Chinese diagnosis indicates specific signs of the defeat of the entire functional system (see table 3), and not a separate structural formation. In other words, the "topical" part of the Chinese diagnosis most likely indicates WHICH FUNCTIONS of the body, and not the organs, are changed by the pathogenic factor, while the "nosological" part often indicates HOW they are CHANGED. As you can see, the Chinese syndromic diagnosis is fully functional.

The modern classical diagnosis, in the vast majority, in the first part contains an indication of the type of morphological (structural) change, in the second - indicates the affected anatomical structure (often these two parts are terminologically merged: for example, cholecystitis - inflammation of the Gall bladder). And only then the state of the function is indicated, but again it is precisely the affected organ, not the system into which this organ is included. Therefore, for complex patients and in case of polysystemic lesions, a "well-established" diagnosis looks like either a multi-story structure or a chaotic set of separate diagnoses when they are made by so-called "narrowly-focused" specialists independent of each other. And if the first option is evidence of the doctor's clinical excellence, the second option is worse for the patient for obvious reasons - "many commanders sink the ship".

Obviously, for the "modern" diagnosis this is characteristic only in the most general form. But it is difficult to deny the morphological orientation of modern diagnostic systems as a whole. Therefore, most of the most modern research methods are aimed at identifying characteristic morphological changes in organs and tissues.

Note. Over the past 20-30 years, revolutionary technologies have literally burst into medical practice to visualize morphological changes in the body: ultrasound, computed tomography, nuclear magnetic resonance, computer blood analyzers. Much less progress is observed in the field of functional diagnostics, where there is a banal automation of the long-known methods of ECG, EEG, rheography, etc. This is a very characteristic tendency.

As you can see, the fundamental difference between the Chinese and the "western" diagnosis really exists: the modern nosological diagnosis is morphologically oriented, and the Chinese is functional. That is why the doctor, without special training, finds it difficult to adequately interpret the Chinese syndromic diagnosis. However, for us, this difference did not become an occasion to consider, for example, the Chinese diagnosis as “good”, and the modern one as “bad” or vice versa. In addition, we are confident that such diverse trends in modern and traditional Chinese medicine can and should complement each other's capabilities. A common field of understanding for a western and eastern doctor is the physiological process, reflected in the state of function of the tissue, organ, system, and the whole organism. Here lies their common language and interests. Finally, the essence of the Chinese diagnosis can be brought to the modern doctor in the only way - by describing in a language that he understands, changes in the functions of organs and systems that are characteristic of various Chinese syndromes. For these purposes, the HPD method was very convenient.

Functional systems and associations in the HPD

Returning to the pulse diagnosis, we recall that the "Chinese organ" always includes a number of anatomical entities, united not by their general location, but by the principle of a functional system. And the pulse at the corresponding points reflects the work of the "Chinese organ", therefore, the entire functional system (FS). Therefore, device-based pulse diagnostics, as a method of functional diagnostics, is based on a modern interpretation of the traditional Chinese concept of organs and, above all, their functions.

Chinese organ = functional system

FS consists of the organ itself (in the anatomical sense) and the corresponding tissues, formations, which are often localized outside the anatomical organ of the same name and perform a certain complex of physiological functions. According to traditional Chinese ideas, six dense and six hollow organs are combined in pairs — dense + hollow — in connection with the performance of closely related functions. Therefore, these associations are considered as a single functional whole - a functional association (FA).

Such a view is not archaic. The approach to the body as a multi-level functional system is in many respects considered to be advanced in medicine. The use of behavioral models of complex functional systems and self-organization of chaos to analyze the activity of the functional systems of the body, to predict the course of the disease and sanogenesis was originated in the nineties of the twentieth century. An example is the analysis of adaptive reactions or predicting the occurrence of arrhythmias. In traditional Chinese medicine, such approaches are a priori the only ones possible, since TCM focuses only on function, and only secondly the doctor is interested in structural changes. For example, diagnostics by language, color, and “body windows” connect changes in the structure of external organs and tissues with changes in the function of internal organs.

Any changes, whether physiological or pathological, are always reflected at all levels of representation and the components of the functional system. This means that changes in the function of the Liver, for example, always cause changes in the function of peripheral nerves, functions of vision, digestion, etc. Thus, in TCM, human physiology and pathology are considered as changes in the activity of a multi-level functional system, where changes at any level are early or later lead to changes at all other levels of the system. It is important to note that all of the above is not only theoretical or philosophical considerations, all this has a direct exit into the practice of an oriental doctor. The technique of device-based pulse diagnostics is based on the same principles.

Table 7. The modern interpretation of the functions of the TCM organs of functional systems and associations

Functional associations of organs	TCM organ	Organs, tissues and formations	Functional systems	Functions
 Fire	Heart	Face, vessels (arteries and capillaries), blood, tongue, heart itself	cardiovascular system, central nervous system (higher functions - mind, emotional sphere)	blood circulation, psychoemotional activity
	Small Intestine	Small Intestine	Digestion	digestion of food, transportation of water and food
	Pericardium	vessels (veins and capillaries), gonads and gonadotropic hormones	Mind, vascular system, endocrine system	Blood circulation (mostly peripheral), psycho-emotional activity, regulation of vascular tone, control of the level of gonadotropic hormones, functional state of internal genital organs
	Triple heater	does not have anatomical representation	water-salt metabolism regulation system	water-salt metabolism
 Earth	Spleen	Spleen, Pancreas, thymus, lymph nodes and blood vessels, connective tissue, ligaments, blood like tissue, subcutaneous fat, muscles, lips	digestion, water-salt metabolism, endocrine system, lymphatic system, muscle system, connective tissue system, gustatory analyzer	digestion, regulation of tissue anabolism (trophic), immunity, cellular coagulation factors, water metabolism, lymphatic system, lymph circulation, muscle trophism, fat and carbohydrate metabolism, taste
	Stomach	Stomach	digestive system	digestion in the upper

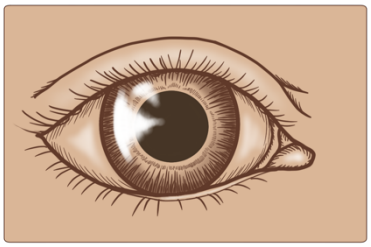
				gastrointestinal tract
 Metal	Lungs	epithelial tissues (skin, respiratory tract, including Larynx, nose, Lungs), hair on the skin	respiratory system, autonomic nervous system, olfactory analyzer	Gas exchange (respiratory function), protective, purification (filtration), detoxification function, thermoregulation, water exchange, smell
	Colon	Colon	digestive system	digestion and absorption in the Colon
 Water	Kidneys	Kidneys, Spinal Cord and Brain, Bone Marrow, teeth, inner and outer ear, hair, internal genitals, Urethra and Anus, Adrenal Glands, gonads		Central neural system, musculoskeletal system, auditory analyzer, Diuresis and urinary system, reproductive system, endocrine system, water-salt balance regulation system
	Bladder	Urinary tract, Spine	Urination	Diuresis and Urination
 Wood	Liver	Liver, ligaments, tendons, peripheral nerves, external genitalia, nails	peripheral nervous system, circulatory system, systems of blood formation, detoxification, digestion, visual analyzer	peripheral nerve function, synthesis of humoral coagulation factors, blood deposition, immunity, detoxification, participation in digestion, vision
	Gall bladder	Gall Bladder	digestive system	accumulation and secretion of bile, digestion

Table 6 shows the morphological and functional correspondences between the concepts accepted in modern medicine and Chinese organs. It is composed in the "classical" genre: the Chinese organ - its functions. The only exception is that the functions of Chinese organs are presented in the language of modern physiology. As you can see, a number of functions

corresponding to the ideas of modern normal physiology are performed by several Chinese organs and, conversely, several organs take part in the work of several functional systems.

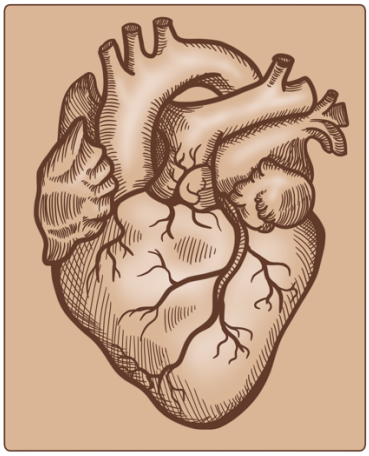
For a doctor unfamiliar with the basics of TCM, this presentation of functional correspondences may be inconvenient. Therefore, we considered it necessary to give a number of tables with a "reverse" diagnostic algorithm (tables 8–21). In our opinion, it is more suitable for the modern clinician. The inverse algorithm is repelled from obviously affected systems, anatomical formations and body functions and leads to affected Chinese organs.

Table 8. Sensory organs



Organs, tissues and functions	TCM organs
Vision	Liver
Hearing	Kidneys
Sense of smell	Lungs
Sense of taste	Spleen

Table 9. The cardiovascular system (CVC)



Organs, tissues and functions		TCM organs
Cardiovascular system in general		Heart
Myocardium		Spleen
Valves and chords of the heart		Spleen
Arteries		Heart
Veins		Pericardum and Liver
Capillaries in general		Heart
Skin capillaries		Lungs
Functions of CVC	The order and rhythm of heart contractions	Liver and Lungs
	Hypertension	Heart (Fire) of Liver and/or Emptiness of Kidneys
	Hypotension	Emptiness of Qi (general syndrome)
	Diastolic pressure	Defined by general Qi
	Systolic pressure	General Qi + Heart, Spleen, Liver

Table 10. Digestive system

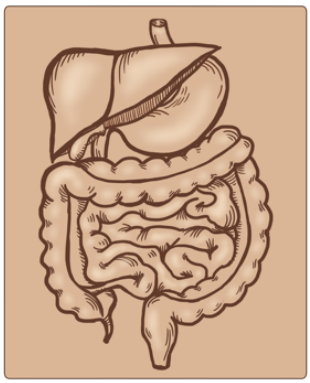
Organs, tissues and functions		TCM Organs
Digestive glands	Salivary glands	Kidneys and Lungs
	Pancreas	Spleen
	Intestinal glands	Spleen
 Digestive tube	Mouth	Spleen
	Tongue	Heart
	Pharynx and pharyngeal lymphatic ring	Spleen
	Gums and teeth	Kidneys
	Stomach	Stomach and Spleen
	Small intestine	Spleen
	Colon	Colon and Lungs
	Liver	Liver
	Gall Bladder	Liver
	Mucosa of the entire digestive tract	Spleen
	Colon mucosa	Spleen and Lungs
Functions	gastric acidity	Yan of Spleen and Liver
	intestinal and pancreatic juices	Yan of Spleen
	bile secretion	Gall Bladder
	peristalsis	Liver
	digestion and assimilation of food	Spleen and Stomach
	detoxification	Liver
	separation of "necessary and unnecessary", intestinal detoxification	Colon
	absorption and active transport of nutrients	Spleen
	water absorption	Lungs, Colon and Kidneys

Table 11. Blood and blood formation

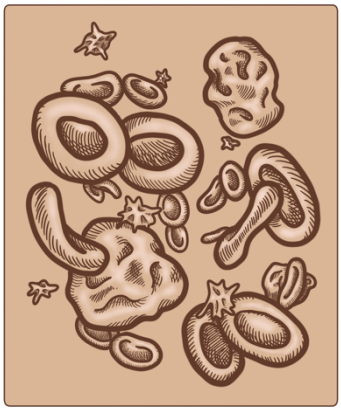
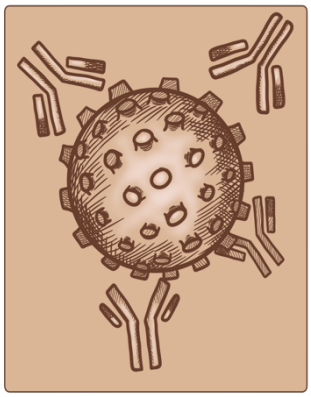
Organs, tissues and functions		TCM organs
Blood in general		Yin of Heart
 Composition	Stem cells and bone marrow	Kidneys
	Red blood cells (q-ty)	Yan of Kidneys, Yan of Heart, Yan of Spleen
	Hemoglobin	Yan of Heart and Yan of Spleen
	Platelets	Spleen
	White blood cells	Spleen
	Blood serum (electrolyte composition)	Kidneys
	Serum nutriens	Yan of Spleen
Functions	Traffic intensity	Lungs, general Qi
	Orderliness of movement	Liver
	„Warming“	Heart and Kidneys
	Thrombosis in arteries and veins, coagulation systems	Liver
	Petechial hemorrhages and mucosal bleeding	Spleen

Table 12. Immunity

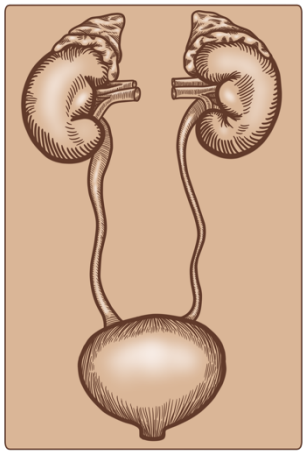


Organs, tissues and functions	TCM organs
Nonspecific resistance	Lungs, Stomach and Kidneys
Specific immunity	Spleen
Immunity of the skin and mucous membranes (large intestine, mouth and throat, lungs and bronchi)	Lungs and Spleen
Cellular immunity	Spleen and Liver
Humoral immunity	Spleen
Autoimmune diseases	Lungs and Liver

Table 13. Endocrine system

	Organs, tissues and functions	TCM organs
 Pituitary Gland and Hypothalamus	operating procedure	Heart
	the tissue itself	Kidneys
Thyroid	tissue	Stomach and Spleen
	function	Yan of Heart
Epithelial body	insulin and glucagon	Kidneys
Pancreas		Spleen
Adrenal glands	corticosteroids	Yan of Kidneys
	adrenaline and norepinephrine	Yan of Heart
Gonads	hormones and tissue	Kidneys
	testicles and tissue	Liver
	testicular hormones	Kidneys
	ovaries	Kidneys

Table 14. Urinary system



Organs, tissues and functions		TCM organs
Tissue	Kidneys, Ureters, Bladder and Urethra	Kidneys
	external genitalia	Liver
Functions	urine formation	Yan of Kidneys and Bladder
	accumulation and excretion of urine	Bladder

Table 15. Respiratory system

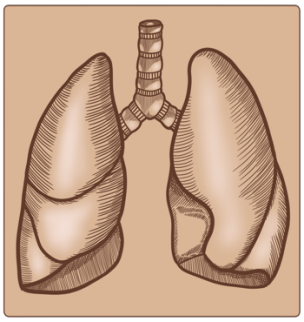
Organs, tissues and functions		TCM organs
Nose and mucosa	sense of smell	Lungs
Mucous membranes of the upper respiratory tract		Lungs and Spleen
Bronchi, Glottis and lung tissue		Lungs
Respiratory muscles		Spleen
Functions 	blood oxygenation	Lungs
	detoxification function	Lungs
	breathing rhythm	Lungs and Liver

Table 16. Reproductive system

Organs, tissues and functions		TCM organs
External genitalia	All	Liver
Internal genital organs	Testicles	Kidneys and Liver
	Ovaries	Kidneys
Uterus	Muscle	Liver
	Menstruation	Spleen, Liver and Kidneys
	Gestation	Kidneys
	Embryo growth and development	Spleen and Kidneys
Genital Mucosa 	except the Uterus	Lungs and Spleen

Table 17. Skin and its derivatives

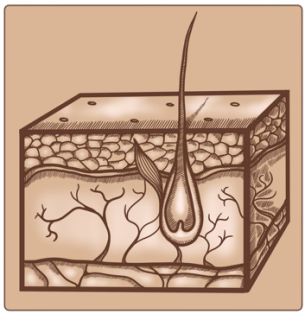
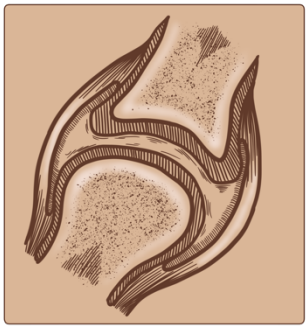
Organs, tissues and functions		TCM organs
Skin in general		Lungs
 Skin on the face	Forehead	Heart
	Nose	Spleen
	Lips	Spleen
	Right cheek	Lungs
	Left cheek	Liver
	Chin	Kidneys
	Eyebrows	Colon
Body hair		Lungs
Hair on the head		Kidneys
Nails		Liver

Table 18. Connective tissue

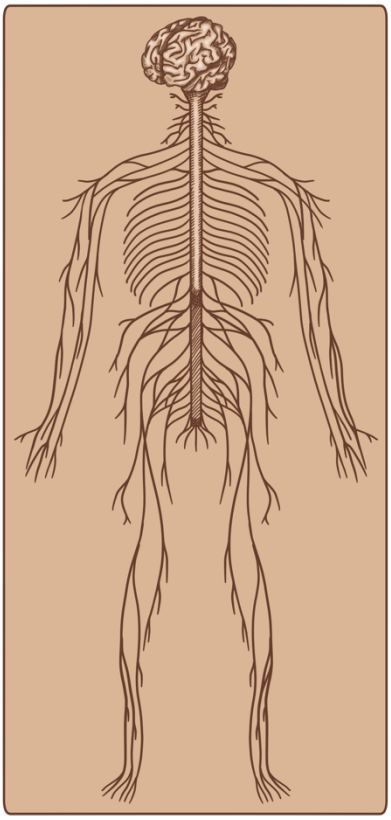


Organs, tissues and functions	TCM organs
Connective tissue in general	Spleen
Organ stroma, ligaments, reticular system	Spleen
Skin and ligament elasticity	Spleen
Cartilage of joints	Kidneys, Spleen

Table 19. Body holes

Organs, tissues and functions	TCM organs
Ears	Kidneys
Nose	Lungs
Mouth	Spleen
Anus	Kidneys
Urethra	Kidneys

Table 20. Nervous system



Organs, tissues and functions		TCM organs
Brain and spinal cord		Kidneys
Vegetative system		Lungs and Pericardium
Peripheral nerves		Liver
Mind and general emotionality		Heart
Emotional manifestations	Agitation, timidity, joy	Heart
	Doubt, indecision, the viscosity of thinking	Spleen
	Despondency, longing, cruelty	Lungs
	Fear (vital)	Kidneys
	Irritability, anger, aggressiveness	Liver
Impaired function	paralysis and cramps	Liver
	sensitivity disorders	Liver

Table 21. Musculoskeletal system

Organs, tissues and functions		TCM organs
Tissue	Bones	Kidneys
	Bone marrow	Kidneys
	Cartilage and tendons	Spleen
	Muscles	Spleen
	Fascia	Lungs
Functions	Muscle strength	Spleen and Lungs
	Synovial fluid hydration	Lungs, Spleen
	Joints trophic	Spleen

The algorithm for using tables is as follows:

Step 1. Based on the leading symptoms, we determine the patient's affected system, tissue, function or anatomical structure (in the modern sense).

Step 2. Select the appropriate table and the desired row in it. According to the selected line, we determine the concerned "Chinese body".

Step 3. In table 6 we find the corresponding "Chinese organ" and compare the patient's symptoms with the tabular data; additionally, determine the possible "parallel" symptoms.

Step 4. We compare the obtained clinical diagnostic data (Step 1-3) with the pulsographic picture.

Such an operation algorithm allows you to quickly and accurately correlate the state of "modern" morpho-functional systems with the quality of functioning of Chinese organs, which is clearly visible on the pulsogram. This makes it possible to confirm or refute diagnostic versions, to understand the general nature of the pathological processes occurring in locus morbi. And in combination with the "classical" correspondence table to find an explanation for a particular symptom complex, not to miss the accompanying pathology. For example, existing clinical symptoms give reason to think about enterocolitis; on the pulsogram, the doctor reveals the corresponding changes in the pulse of the Spleen and Lung, which confirms the clinical version; Using the "classical" correspondence table, the doctor can easily determine which organs, tissues and functions can also be affected, why the patient is simultaneously irritated by the upper respiratory tract and a syndrome of decreased surface immunity.

Parts of the pulsographic complex and their functional correspondence

The work of any relatively complex functional system consists of the activities of its individual functional elements. Some of them provide the work of other elements of the system, others are occupied with those functions, for the implementation of which the whole system exists. Therefore, conditionally the operation of a functional system can be divided into "external" and "internal" function. The first is the contribution of the system to the activities of systems of a higher hierarchical level. The second is mainly aimed at maintaining the operability of this very functional system. For example, the activity of the digestive system for the digestion of food, absorption, etc., can be considered as an "external" activity. And metabolic processes that are aimed at maintaining the integrity of the mucous membranes and other tissues of the digestive system, the secretion of digestive hormones, etc., are defined as the "internal" function. In most cases, internal function is equivalent to the metabolism of organs and tissues, since metabolic processes are the foundation for maintaining the morphological and functional integrity of organs and tissues.

Such a difference, however, is very relative. If we consider the organism as a hierarchical set of functional systems of various levels, then no matter what level we consider, the function of the subsystems will always be "internal", and the function of the metasystem will be "external". However, when considering a single system, this separation is useful.

Pulse diagnostics, as we have said, is a functional diagnosis. In the study of its capabilities in this capacity, it turned out that the pulsogram allows you to evaluate both the external and

internal functions of the organ (system). It was revealed that the section of the pulse complex, consisting of deflections S and R, reflects mainly the external functional activity of the organ and therefore was called the functional section (section 1 in Fig. 23). It corresponds to the external function of the organ. The site of the pulsographic complex, consisting of F, U, and E teeth, to a greater extent reflects the characteristics of the metabolism (internal function) of the corresponding tissues and is called the metabolic site (section 2 in Fig. 23). This site corresponds to the internal function of the organ. The remaining portion of the deflections M, V, and Q reflects the functionally least active phase and therefore has no significant diagnostic value.

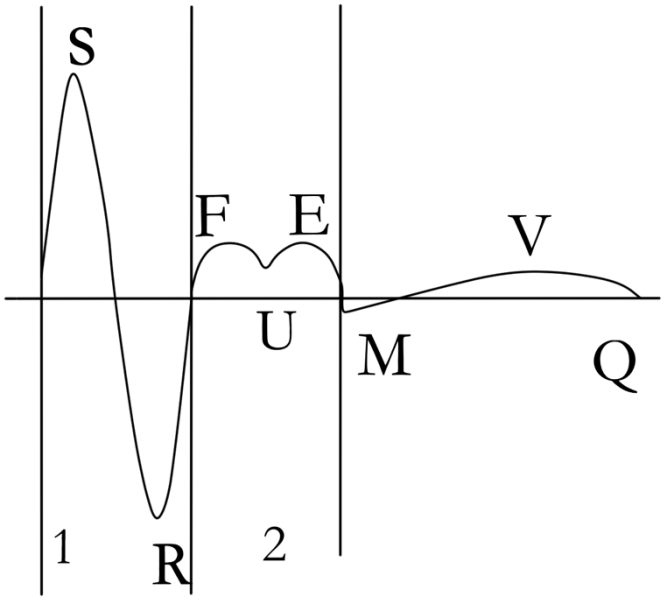


Figure 23. 1 — functional area, 2 — metabolic site.

Pulsographic terms

To decode the pulsogram from a functional point of view, we have introduced a number of terms that describe various characteristics of the functioning of the physiological system.

- **Level of functioning**
  The characteristic of the "power" of functioning reflects the functional activity and current energy consumption of the system. The indicator must be considered not from the point of view of the absolute norm, expressed by a numerical corridor of values, but in the context of the current functional load. Regardless of the absolute value of the level of functioning, the correspondence of the energy consumption of the system to the real functional load (physical or emotional) can be considered to be its norm.

- **Efficiency**
  The indicator reflecting the efficiency of the system, which decreases with functional overvoltage. It is important that the effectiveness of functioning does not reflect the degree of functional activity. But the decrease in the indicator in combination with the level of functioning gives an idea at what level of external load this system begins to work with overvoltage. Significant decrease in efficiency at low level of functioning indicates a breakdown of the adaptive capabilities of the system, i.e., its decompensation.

- **Level of adaptive reserves**
  It characterizes the amount of available reserves that can be used by the system in adaptive-adaptive processes. Both an increase and a decrease in this indicator are possible in comparison with the average "normative pulsogram". It should be borne in mind that persistent deviations of the indicator from the norm in both directions are a sign of a trouble.

- **Ability to accumulate adaptive reserves**
  An indicator characterizing the anabolism of the functional system. Unlike the Adaptive Reserves Level indicator, this parameter reflects the system's ability to accumulate and hold functional reserves.

- **Tissue metabolism**
  The indicator evaluates the activity of interstitial metabolism of the system in relation to the conditional norm. A decrease in the indicator — a slowdown in tissue metabolism — indirectly indicates dystrophic processes in the system, and an increase in the indicator and, correspondingly, an increase in tissue metabolism indicate reparative or inflammatory processes.

- **Tissue dystrophy**
  An indicator that determines the presence or absence of tissue degeneration of the functional system. In the ADF, the indicator is of a qualitative nature and has two gradations - whether it is or not.

- **Level of regulation**
  It reflects the adequacy of the predominantly autonomic nervous regulation of the processes and functions inherent in the functional system, their spatial and temporal synchronization.
  The state of the organism as a whole is determined by the following parameters, which are derived from the parameters characterizing the state of individual functional systems:

- **The level of functional activity of the body**
  It is a quantitative indicator reflecting the "power" of the functioning of the whole organism as a whole. This indicator is closely related to the level of basal metabolism.

- **Adaptive level**
  An indicator characterizing the average level of adaptive capabilities of the organism as a whole.
- **Intersystem functional balance**
  The most important indicator characterizing the balance of processes occurring in different functional systems (intersystem homeostasis).

- **Violations of the central regulation of functions**
  The indicator reflecting the presence and severity of regulatory disorders in the body. Or reflecting the degree of disintegration of regulatory adaptive mechanisms. Based on the terms we introduced, table 21 presents the functional interpretation of pulsographic signs.

Table 22. Functional interpretation of pulsographic signs

PG deflection	Diagnostic signs	Functional meaning	Sign category
S	Decreasing in amplitude	Decreasing of functionality level	Main
	Increasing the amplitude	Increasing of functionality level	Main
	bifurcation of the deflection (the appearance of the sign S ')	Decreasing of efficiency	Main
	relative reduction of the width ("awl-shaped S")	A critical decrease in performance. Active depletion of energy and substrate reserves due to functional overvoltage.	Main
R	Decreasing of amplitude	decrease in adaptive reserve accumulation ability	Main
	Expansion of the deflection	decrease in the ability of the system to accumulate adaptive reserves associated with a violation of the quality of the substrate	Main
	formation of a kink at the apex on the descending part of the deflection R	Chronic decrease in the efficiency	Confirmed
	formation of a fracture on the ascending part of the deflection R	slowing down metabolism with a decrease in substrate quality	Confirmed
F	increase in amplitude (the peak is higher than the peak of the deflection E)	The current (situational) excess of adaptive reserves due to a shift in the balance of consumption / receipt of the substrate towards its accumulation	Main
	deflection F is located below the contour	Decrease of adaptive reserves level	Main
	pointing of the top	increased energy expenditure, a tendency to inflammatory processes with increased tissue metabolism	Confirmed
	narrowing of the deflection	metabolic changes leading to tissue dystrophy due to insufficient tissue nutrition	Main
	deflection expansion	metabolic changes leading to tissue dystrophy due to insufficiency of anabolic processes	Main
E	pointing of the top	tendency to inflammatory processes with increased tissue metabolism	Confirmed
	deflection expansion	not determined	
U	decrease in amplitude or complete absence of a deflection	decreased tissue metabolism	Main
	increase of the amplitude of the deflection	Increased tissue metabolism, possibly inflammatory processes	Main
Q	deflection Q below the contour	not determined	
High-frequency oscillations on any tooth		violation of the synchronization of the activity of functional subsystems, a decrease in the level of regulation of FS	Main
"Cutting off" the top of any deflection		Non-optimality of function associated with acute regulatory dysfunctions	Confirmed

FUNCTIONAL PULSOGRAPHIC CONCLUSION

Depending on the plot of the use of HPD, the role of clinical data may be different. However, as with the interpretation of the pulsogram in terms of TCM, accounting for clinical data is required in all cases. In prophylactic studies, clinical data are absent or scarce and not very specific. The role of pulsodiagnostics in such cases is to concentrate the doctor's attention on certain organs and systems in which signs of impaired functioning are detected. The combination of pulsodiagnostic data with the available microsymptomatics even in practically healthy individuals allows us to solve a number of problems (see further in table 22).

When examining obviously sick people, accounting for clinical symptoms is even more important. HPD data become diagnostically significant only in combination with the existing symptoms and focus the attention of the pulse researcher on specific organ associations and systems, functional connections between them. This makes it possible to reveal hidden pathophysiological mechanisms and explain the presence of one or another symptomatology. Depending on the specific goals of the diagnosis, the functional diagnostic conclusion can be different: either a detailed conclusion on all functional systems and organs, or a narrower one that treats specific symptoms.

The formation of a functional pulsographic conclusion is carried out in two stages:

- Assessment of the status of each of the 6 functional associations (FA);
- Formation of a general conclusion about the functional state of the body.

Assessment of the State of Functional Association

It has already been said above that the functions of paired organs in Chinese medicine are interconnected. These connections are so strong that without stretch it is possible to speak of a single "external" function of these organs. Therefore, with pulse diagnostics, the state of the entire functional association (FA) is evaluated immediately, and not individual pulsograms of the hollow and dense organs. If paired pulses of the association clearly differ in their parameters, then the association has "internal disharmony". In this case, the total assessment of the functional state of the association is carried out mainly by the state of the dense organ, since the functions of the hollow organs are auxiliary to the corresponding dense organs.

Level of Functioning

Estimated by the height of point 2 above the contour. The level of functioning is considered normal if, in the studied pulsogram, the vertical distance of point 2 from the isoline is within 0.9 - 1.1 of the position of point 2 of the normative pulsogram. If the vertical distance of point 2 deviates from the indicated values in the direction of increase or decrease, the level of functioning is considered, respectively, "high" or "low".

Efficiency

Evaluated according to the deflection pattern S. An indicator reflecting the optimal functioning of the system. The efficiency of functioning is within normal limits if the S wave is smooth and has standard proportions (the ratio of the width of the tooth to its height is from 1: 2 to 1: 3, 5). If there is an additional vertex on the deflection S (sign S') above the contour, the efficiency of functioning is considered to be "reduced". When the additional vertex is located below the contour (transition to the deflection R) - "low", and with a pointed, "awl-shaped" shape of the deflection S - "critically low". The amplitude of the S wave for evaluating this indicator is not of fundamental importance.

Level of Adaptive Reserves

Determined by the location of the top of the deflection F relative to the contour and the top of the deflection E. Reflects the operational supply of nutrients and energy substrate. The level of adaptive reserves is considered normal if the tip of the deflection F is between the isoline and the level of the peak of the deflection E. If the top of the deflection F is above the level of the top of the E wave or below the isoline, this parameter is considered "raised" or "low", respectively.

Note. Along with the "low" level of adaptive reserves, the "increased" level is also pathological, because it reflects the blocking and stagnation of normal energy in the system. With a very low amplitude of all the teeth of the pulse complex and in cases where the determination of the teeth is generally difficult, we can talk about the obviously low level of adaptive reserves, i.e. diagnosed as a "decrease" or "pronounced decrease."

Ability to Accumulate Adaptive Reserves

Is determined by the amplitude and shape of the deflection R. The accumulation rate of adaptive reserves is considered normal if the deflection R height is 0.6-1.0 S wave height and low if this value is less than 0.6.

Tissue Metabolism

Determined by the position of the top of the deflection U relative to the top of the deflection F. Reflects the total intensity of metabolic processes in the tissues of the functional association. Tissue metabolism is normal if the distance between the vertices of the deflections F and U vertically is within the same value on the normative pulsogram. If this distance is reduced, tissue metabolism is considered "reduced". In the opposite case, tissue metabolism is "increased."

Tissue Dystrophy

Determined by the ratio of the width of the deflections F and E. This indicator is a qualitative characteristic of the nutrition of tissues. The indicator is calculated by comparing the widths of the F and E deflections. To do this, a horizontal line is drawn through the top of the deflection U (parallel to the contour) until it intersects with the ascending part of the F wave and the descending part of the deflection E. The distance between the intersection point of this line with the ascending part F and the vertex U is the width of the deflection F, and between the vertex U and the point of intersection of this line with the descending part E is the width E. If the vertex U (point 5) is below point 7, then the width E is measured from the vertex U to the projection point 7 on the drawn horizontal line.

Tissue dystrophy is absent if the ratio of the width of the deflection F to the total width of the deflections F and E (Ha at the top of the deflection U) is in the range of O, 45 - O, 7. With a change in this ratio, both upward and downward, tissue dystrophy is considered "high".

Level of Regulation

Determined by the presence or absence of high-frequency oscillations mainly on the deflection V. The control level is considered normal if there are no high-frequency oscillations on the deflection V or there are single oscillations of insignificant amplitude. When a significant number of oscillations with an increased amplitude appear on the deflection V and / or on the deflections F and E, the level of regulation is considered "low".

Conclusion of Functional Association

The conclusion on functional association (FA) is an integral assessment of the state of the association, consisting of functional systems of paired dense and hollow organs. The state of FA is generally determined by the parameters of the pulsogram of a deep pulse, i.e. according to assessments of the state of a functional system (FS) of a dense organ and according to the level of functional balance between both FSs.

The level of the functional balance between the functional systems of FA is determined by comparing the estimates of the same parameters of both FS. If five or more of any parameters of the same name coincide in norm or in deviations from the norm, the level of the functional balance of FA is considered normal. If four or fewer parameters match, "low".

Formation of the General Conclusion on the Functional State of the Body

When assessing the functional state of the body as a whole, systemic parameters such as the level of functioning of the body, the level of its adaptive reserves, as well as the level of regulation and intersystem functional balance are recorded.

General level of functioning

The overall level of functioning is considered normal if four or more FAs have a “normal” level of functioning. If three or more FAs have a "high" or "low" level of functioning, then the overall level of functioning is considered respectively "high" or "low". In individual cases, when it is impossible to distinguish a group of FAs with a predominance of any level (for example, two FAs have an increased level of functioning, and one or two have a decreased level), they diagnose an unstable “transitional state” of the body.

Intersystem functional balance

This is the most important systemic indicator of the functional state that determines the operability of central regulatory systems, as well as the likely severity of the pathological process. Intersystem functional balance is considered normal if the functioning levels of four or more FAs have the same indicators, regardless of the level of functional activity, and low if the same indicators have three or less FAs.

General level of adaptive reserves

This is an indicator reflecting the total operational stock of adaptive reserves of functional subsystems. The general level of adaptive reserves is considered normal if four or more FAs have a normal level of adaptive reserves, and "high" or "low" if three or more FAs have a correspondingly high or low level.

General level of regulation

The general level of regulation is considered normal if four or more FAs have a normal level of regulation, and “low” if three or more of them have a low level of regulation.

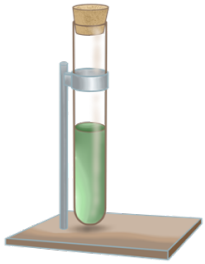
THE POSSIBILITIES OF HPD AS A METHOD OF FUNCTIONAL DIAGNOSTICS

Device-based pulse diagnostics as a method of functional diagnostics provides the widest information on the activity of the main organs and systems. Therefore, it is equally informative both for examining patients and for assessing the state of healthy people.

We emphasize once again that the HPD allows you to accurately judge the performance of functional systems and only indirectly assess the morphological state of organs and tissues. The plots of the application of this option of pulse diagnostics can be diverse. The main areas of application of functional pulse diagnostics are given in table 22.

In the process of developing a functional interpretation of pulse diagnostics, HPD was used in practice in all these areas, so we can talk about high diagnostic value, reliability and effectiveness of the method.

Table 23. HPD as a method of functional diagnostics — field of application

Application area	Purpose of diagnosis	Diagnostic information
Preventive research 	Diagnosis of "healthy health" including research and sports medicine	Adaptive and functional reserves, resistance to diseases and workloads, health forecast
	Preclinical disease detection	Identification of systems with intense functioning and depletion of adaptive reserves
	Large contingent survey	Identification of the type of response of the human body to a set of environmental factors, including production, indirect environmental monitoring
Diagnostic research (patients) 	Diagnostic studies of patients with a specific pathology	Determination of the state of adaptive mechanisms — compensation/ decompensation, features of intersystem interactions
	Diagnostically complex cases	Clarification of pathogenetic mechanisms with determination of the state of adaptive systems, additional data for differential diagnosis
	Associated diseases	Determination of the leading pathogenetic link, the establishment of causal relationships in the formation of combined pathology

CASE STUDIES IN COMPUTER PULSE DIAGNOSIS

Case 1 – A Study of Athletes

21 athletes of a soccer team participated in the research. The research was carried out using the clinical diagnostics method and the computer pulse diagnostics method. It was carried out two times per year: at the beginning and in the middle of seasonal training. Furthermore, the study was executed before and after each training session. The clinical diagnostics method consisted of examinations of a therapist and a vertebrologist, heartbeat registrations, arterial pressure at rest.

Pulsographic evaluations of the computer pulse diagnostics method were performed by interpreting functional parameters of the organism. The state of the organism was evaluated by these parameters:

- The level of functional activity of the body (average, high, very high, low, very low);
- Adaptive level (high, average, low);
- Intersystem functional balance (satisfactory, unsatisfactory, expressed functional imbalance);
- Violations of the central regulation of functions (none, moderately expressed, significantly expressed).

Furthermore, six functional systems were evaluated by the pulsographic data: hearth–blood vessels, respiratory, digestion, kidneys and bladder, liver, central and vegetative nervous systems. Each of their condition were established by these parameters:

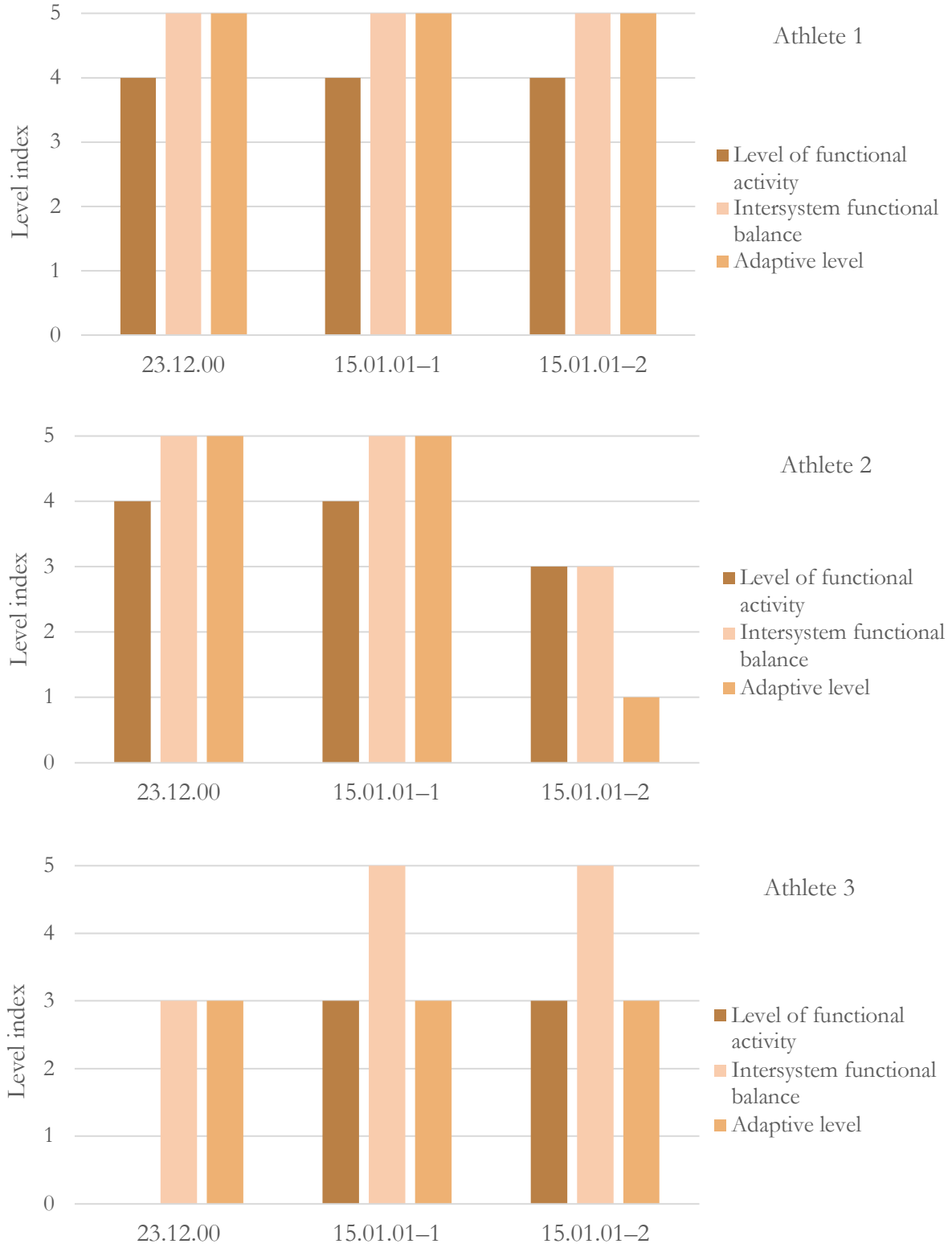
- Level of functioning (rate limit, moderately reduced, reduced, significantly reduced, moderately increased, increased, significantly increased);
- Efficiency (adequate load, some load, congestion, pressure with exhaustion);
- Level of adaptive reserves (satisfactory, reduced, excess accumulation) and ability to identify them (the norm, reduced, significantly reduced);
- Tissue metabolism (optimal, slightly increased, increased, significantly increased, slightly reduced, reduced, significantly reduced) and tissue dystrophy (none, slightly expressed, significantly expressed);
- Regulatory violations of the system (none, slightly expressed, significantly expressed);

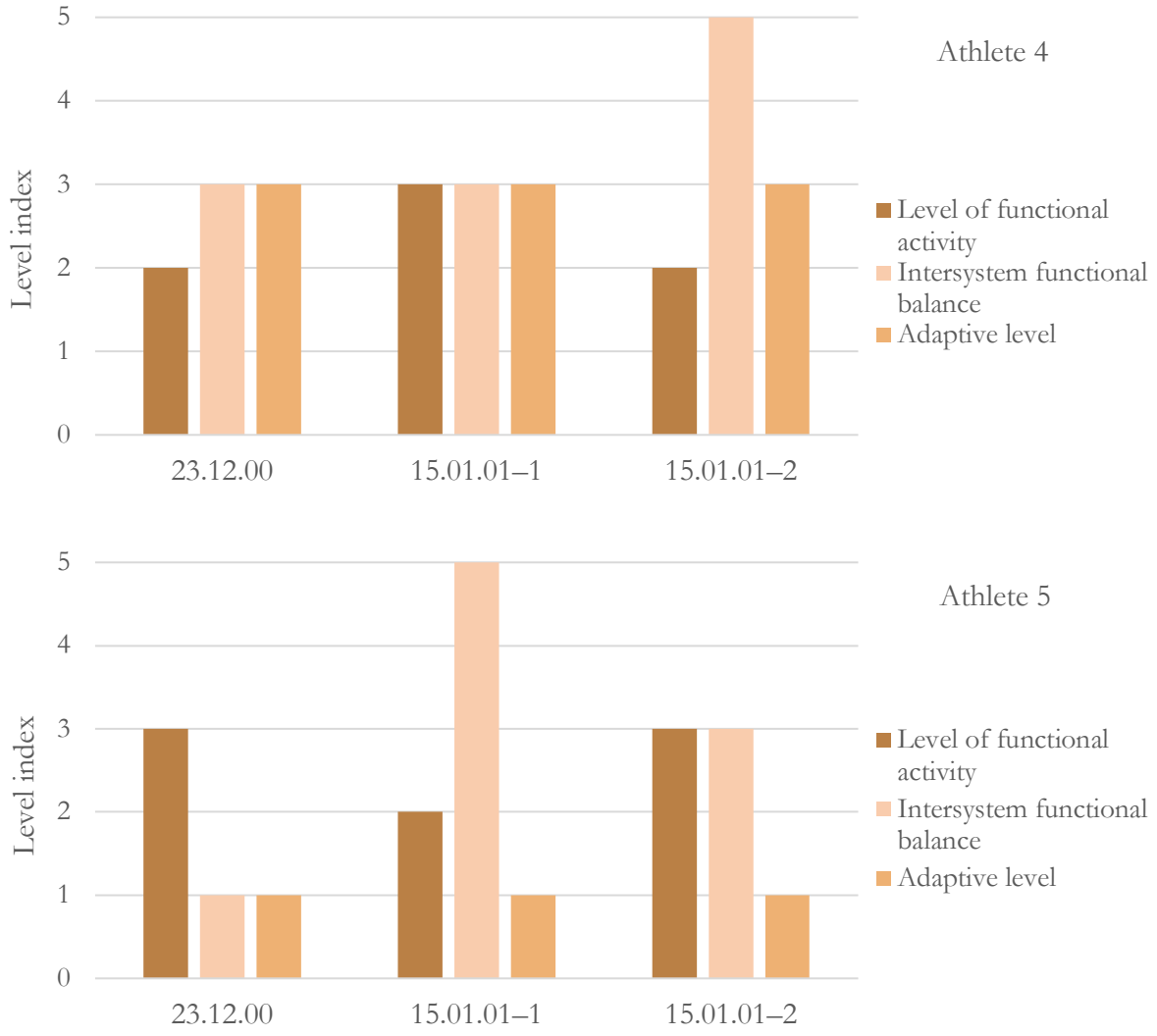
Results

During clinical inspection, the athletes' main complaints were exclusively on sports focused traumas: back pains, previously injured areas, pain in joints. However, there were no somatic complaints amongst the athletes. This shows that the athletes covered their somatic problems and inconveniences, which allowed to foresee their precautious approach to medical studies. The standard clinical study of a sports team members did not provide any information neither on existing chronic ailments, nor on the health level, and especially not on the athletic form. Knowing this, of course, does not provide the basis to consider discarding the simple medical examination, however it does emphasize the specifics of sports doctors.

Unlike the clinical examination, the results from computer pulse diagnostics were significantly more informative when evaluating the functional state of the athletes. When analyzing findings using computer pulse diagnostics method, the evaluation was carried out on two levels:

level of functional systems and level of organism totality. Direct "capacity" characteristics of functional systems were evaluated (level of functioning of the system and its load), as well as those characteristics which are the foundations to capacity, or the resource for the system (adaptive reserves, ability to replenish them, tissue metabolism and outer operation regulation of functional systems). This way the pulsographic rendering allowed to evaluate not only the outer efficiency effect, but also to reveal that or other functional formation mechanisms. Some of the results are shown in the following graphs:





15.01.01–1 – until training; 15.01.01–2 – after training.
Level of functional activity: 1 – very low; 2 – low; 3 – average; 4 – high; 5 – very high.
Intersystem functional balance: 1 – functional imbalance; 3 – unsatisfactory balance; 5 – satisfactory balance.
Adaptive level: 1 – low; 3 – average; 5 – high.

Assessing the state of the organism overall, firstly focus was shifted towards intersystem functional balance, since only balanced functions can provide optimal adaptation to any kind of pressure, including sports load. Primary study revealed that the health and sports form characteristics amongst sports team members were different. In essence, a good sports form could be concluded only to 5 members (23,8%). To the vast majority (10 athletes – 47,6%) physiological problems occurred, requiring correction. For 6 athletes (28,6%) significant deviations of functional condition appeared.

In sum, the "functional portrait" of the sports team appeared to be debilitating: high level of functional activity, satisfactory level of adaptive reserves, average functional balance, and averagely reduced level of regulation. It was taken into account that a high level of functional activity was supported by high activity of nervous, digestive and support–movement systems,

which showed a high level of game and training load. Regardless, for the majority of athletes this kind of increased functional activity was nonoptimal, causing pressure leading to the dissipation of adaptive reserves. Simultaneously, a low level of functional activity was found in one third of the athletes in hearth–blood vessels and respiratory systems, subclinical damage of the blood circulation in the brain. Likewise, 4 athletes with a suspicion of subclinical somatic pathology were assessed.

Based on clinical and pulse diagnostics only 6 out of 21 athletes were assigned to additional laboratory and instrumental examinations, confirming the absence of pathology. Recommendations for working with each athlete were given to the doctor and coach.

Conclusion

1. Computer pulse diagnostics can be a valuable instrument for evaluating the health status of athletes. This method allows to measure athlete's physical form quickly and relatively accurately, determine their reaction to the provided load, as well as determine the adequate load for each athlete.
2. Strong pros of this method: using the collected data all the functional systems and overall status of the organism can be accurately evaluated in a relatively short amount of time (7–10 min). Furthermore, a dynamic evaluation of organism's main functional indicators before and after physical load, can provide an opportunity to evaluate the athlete's reaction to the load, to objectively evaluate functional and adaptive reserves, to evaluate their time of recovery, to indicate the athlete's "weaknesses".
3. The use of computer pulse diagnostics method allowed to reduce the time of examination, without any losses to the quality and quantity of diagnostic information.
4. Computer pulse diagnostics equipment is mobile and portable, allowing control over the athletes' functional condition during training sessions.

The obtained data about athletes' physical and psychological well–being was useful to the coaches (to optimize the process of training), to the team management (for formulating the main and reserved structure), as well as to the doctor of the team (additional data for maintenance check–up, preventing illnesses and conducting individual health programs).

Case 2 – Acne

Patient M., 25 years old, complained about pus-filled skin rashes on the chest and back. The onset of rashes was said to be two months ago on the face, which later spread to the torso. Intensity of the rashes only increased. After examination, acne vulgaris was diagnosed on the face and torso. Somatic state – without pathology.

According to the pulsographic (figure 24), when there's a relatively low amplitude of every pulse, the high amplitude pulse of gallbladder stands out, when there is a low amplitude liver pulse (a disbalance in the pair is dense – a hollow organ). Furthermore, there are clearly reduced functions of the large and small intestine. In result, the main focus of the therapy is shifted towards the normalization of gallbladder and liver functioning, and the restoration of intestine functioning. Local treatment was not applied. After two weeks from the start of the therapy the inflammation decreased, there were no signs of new skin rashes. Later, after a month, the intensity of the rashes diminished twofold, and after yet another month – practically disappeared. After a repeatedly carried out computer pulse diagnostic (figure 25) the amplitudes of pulse components practically leveled off, even if the pulse for gallbladder remained somewhat heightened according to the amplitude, compared to others. Intestine functioning was revived, liver functioning improved. Aside from the improved clinical state, therapy cannot be finished, since pulsographic deviations could still be seen in the functions of liver and lungs, which are responsible for skin conditions and superficial immunity. For this reason, therapy was extended for two more months, so that the result could be fixated.

Acne is related to skin receptors' increased sensitivity to androgens, microbial damage of the surface of the skin, and other changes to the organism. It is problematic to treat this kind of ailment. In this case, the evaluation of the organism using the computer diagnostics method allowed to quickly determine the main problems of the organism, to decide the time, and choose an appropriate treatment plan.

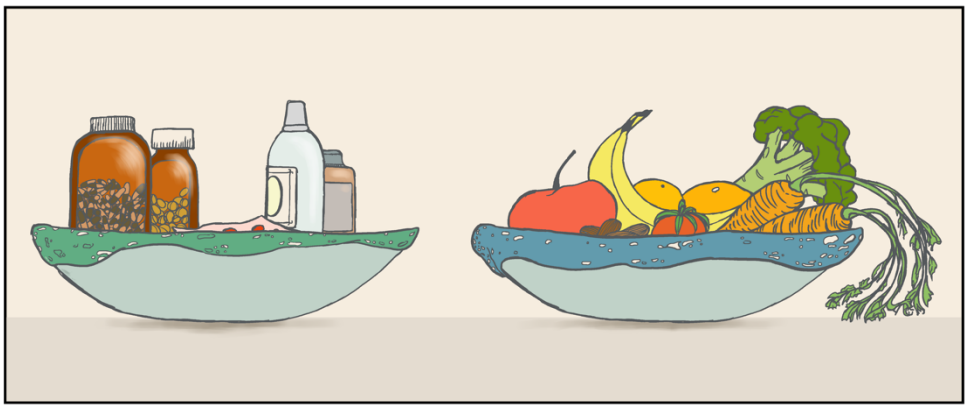
Case 3 – Overall Health

Patient G. L. S., 66 years, complained about all sorts of ailments in practically every organ and system, out of which her main complaint was weight loss, muscle asthenia, lack of appetite, diarrhea. Objective evaluation: significantly reduced diet, yellowish skin, sagging skin, no subcutaneous layer, atrophic muscles, movement only with support. After the first examination, laboratory and additional tests, the main proposed hypothesis – oncological cachexia – was ruled out. Together there was the whole baggage of pathologies of the elderly: irritated bowel syndrome, atherosclerotic cardiosclerosis, chronic gastroduodenitis, chronic enterocolitis, hepatosis, chronic pancreatitis, chronic cholestitis – cholangitis. A question was raised: where should the treatment start from?

In the first pulsograph (figure 26) pathological deviations are seen in pulse measurements of every functional system. A clear tendency to hyperfunction could be viewed in liver, gallbladder, stomach and spleen systems, whereas in other functions there is clearly a tendency for hypofunctioning. By examining in more detail, the efficacy of digestive organ systems is severely low (deep S'), with indications to active inflammation (deepening of deflection U'), which is why indications of hypofunctioning were assigned to inflammation. In sum, a treatment plan was created to correct the state of acutely inflamed organs: stomach, pancreas, and liver.

The next appointment was set after seven days: appetite had appeared, stools had softened, the quality of sleep had increased, muscle strength had appeared. After a month and a half, the condition became satisfactory and stable, appetite appeared to be good, soft stools, she gained 4 kg of weight. Pulsographic dynamics met the clinical dynamics (figure 27). The deepening of deflection U' had disappeared, which indicated the absence of inflammatory processes. Reduced depth of deflection S' indicated an increase in pancreas efficacy levels. All other signs of improvements in functional systems were also noticed, especially in kidneys and pericardium. This means that the treatment was selected properly, and the healing process covered the organism as a whole, not only the treatment focused organs.

Even if, according to the pulse measurements, pancreas enzymatic function was not sufficient, as well as a noticed stomach hypersecretion and signs of low liver efficacy (sharp S', widening of deflection F). In result, the treatment was shifted towards pancreas exocrine function stimulation and correction of liver performance. The treatment was carried out in phases, both clinically and using the pulsographs. The patient was monitored every 1–1,5 months. After a year since the first appointment, the patient did not have any complaints, she gained 6 kg, became physically active – every day walks 6–10 km. Pulsograph (figure 28) during the control visit was relatively harmonious, respiratory system functioning had decreased in moderation.



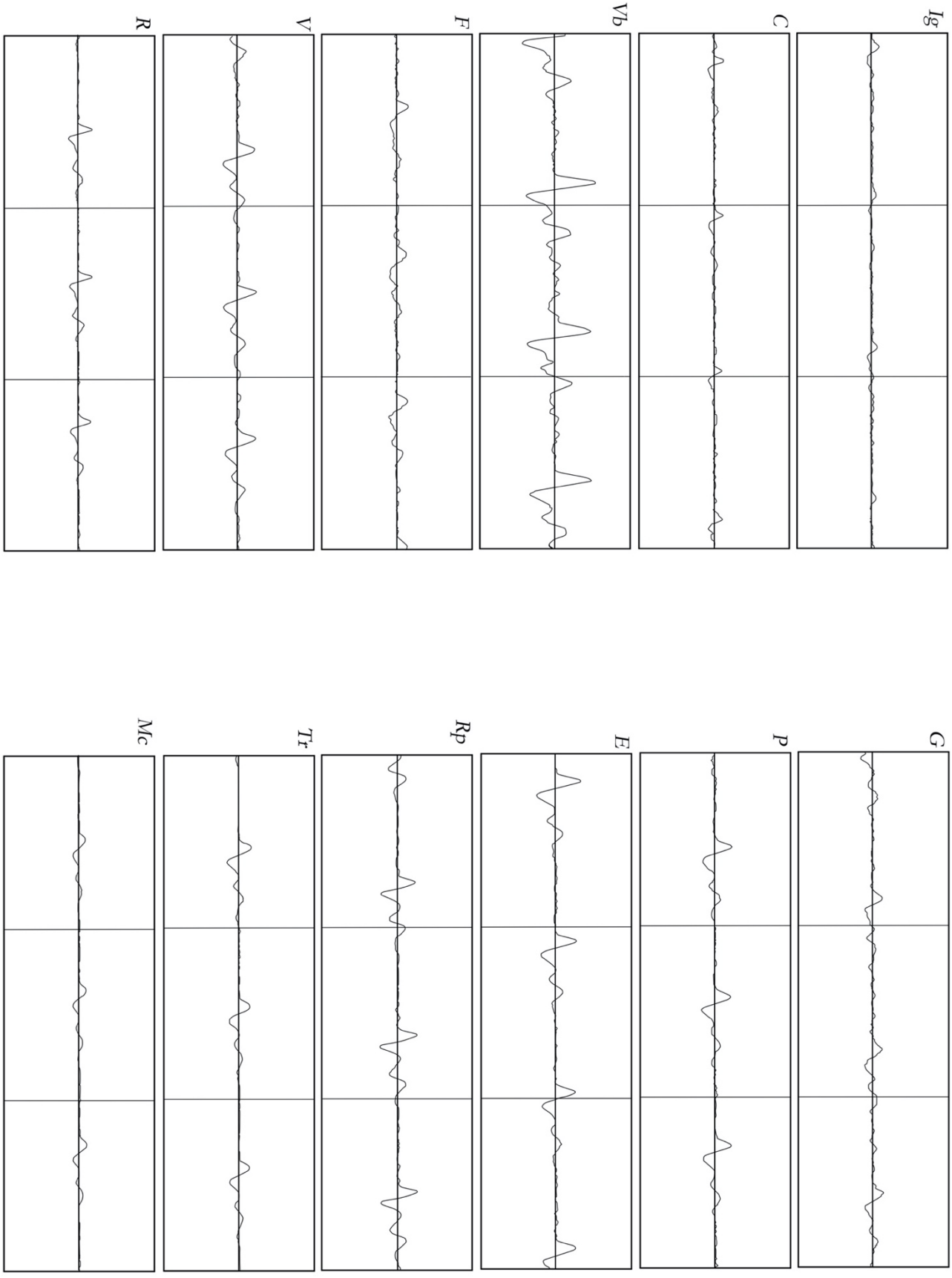


Figure 24. Acne case. High amplitude pulse for Gallbladder in the presence of low amplitude pulse for liver + apparent functional reduction of the large and small intestine.

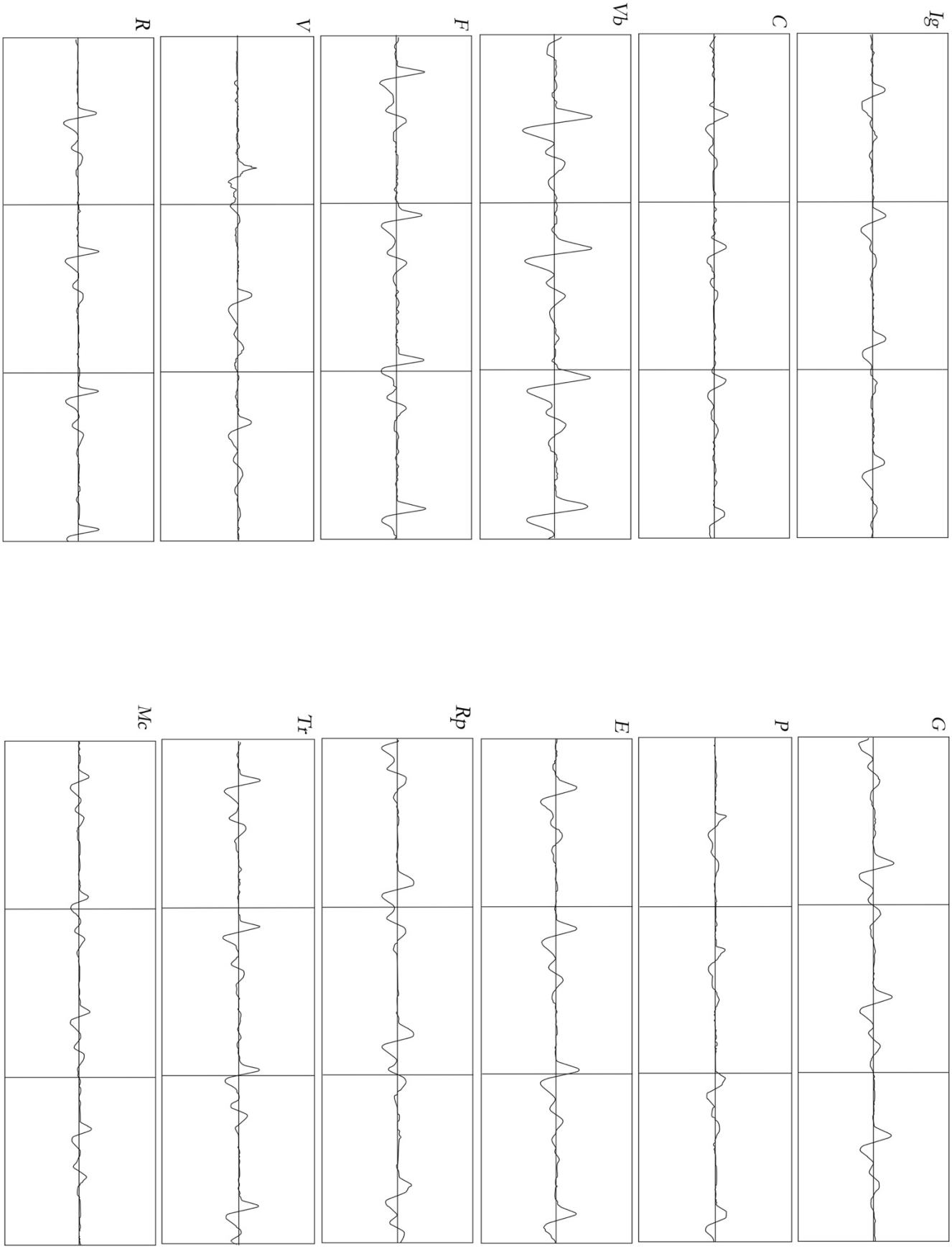


Figure 25. Acne case. After treatment: gradual pulsographic amplitude leveling, including the pulse of Gallbladder.

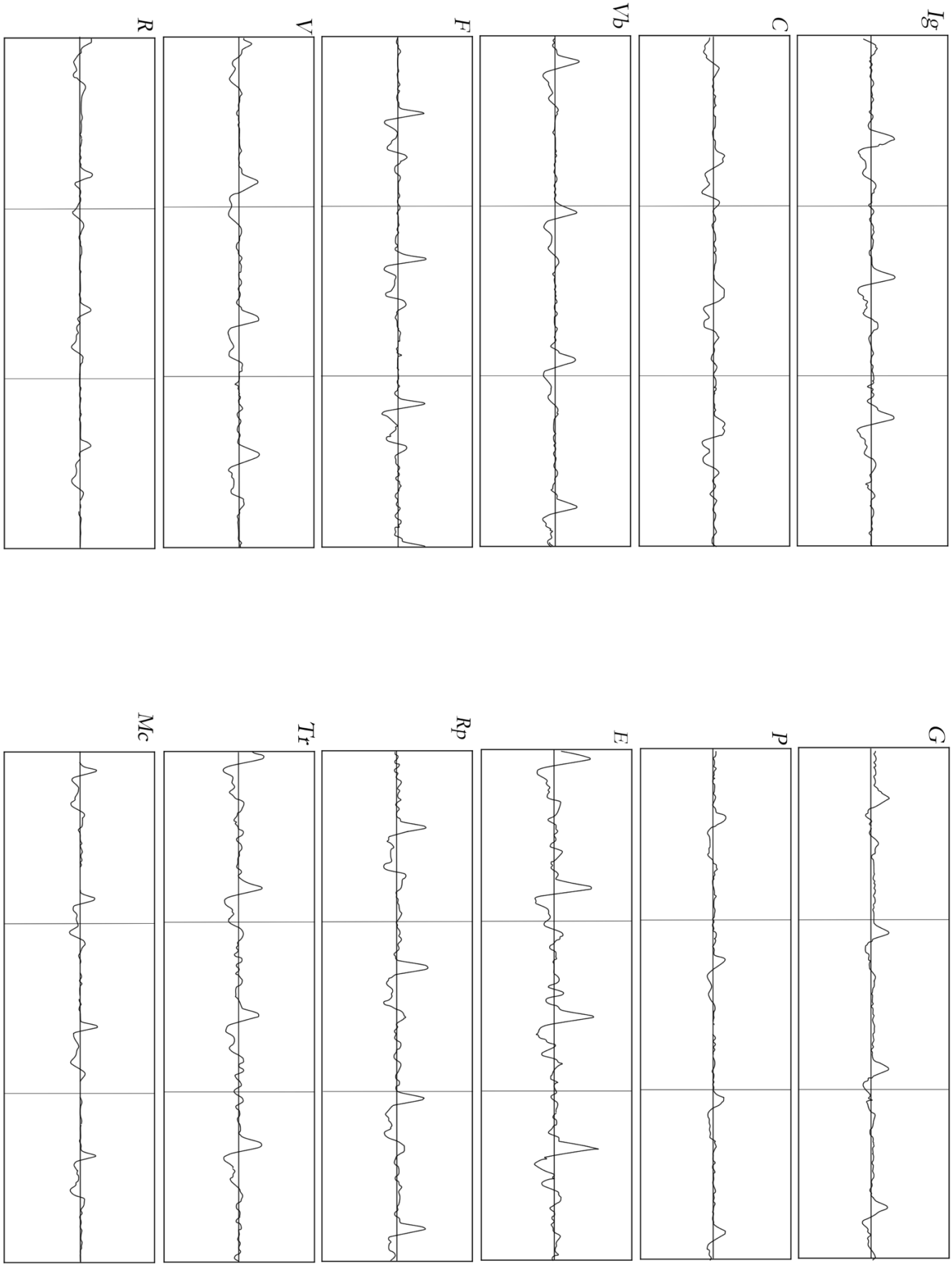


Figure 26. Predicted trend to Liver, Gallbladder and Stomach hyperfunction in the background of other remaining functional systems.

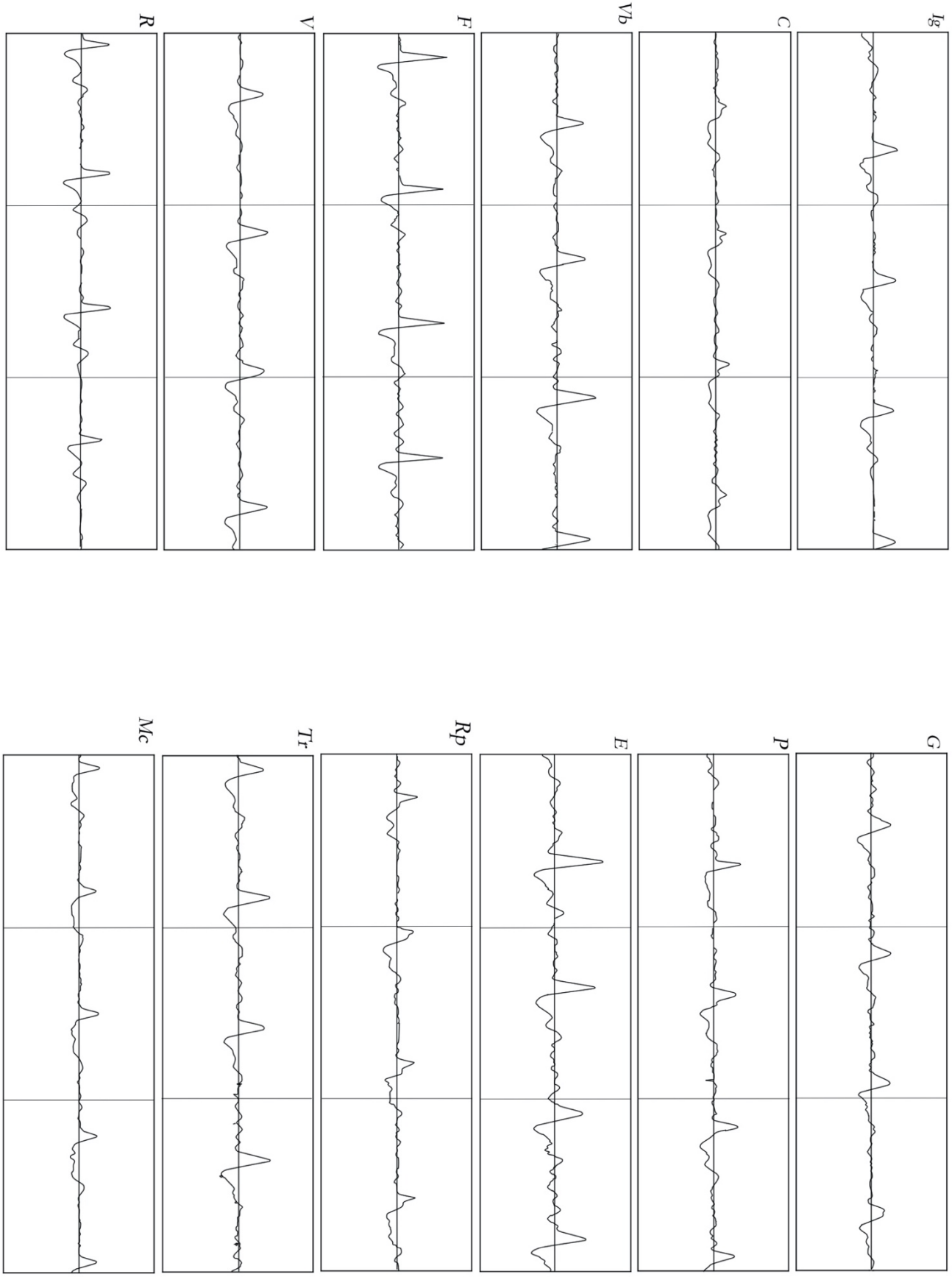


Figure 27. Clear hyperfunction of Liver, Gallbladder and Stomach in the background of other functional systems after treatment: dynamics on the indicated organs.

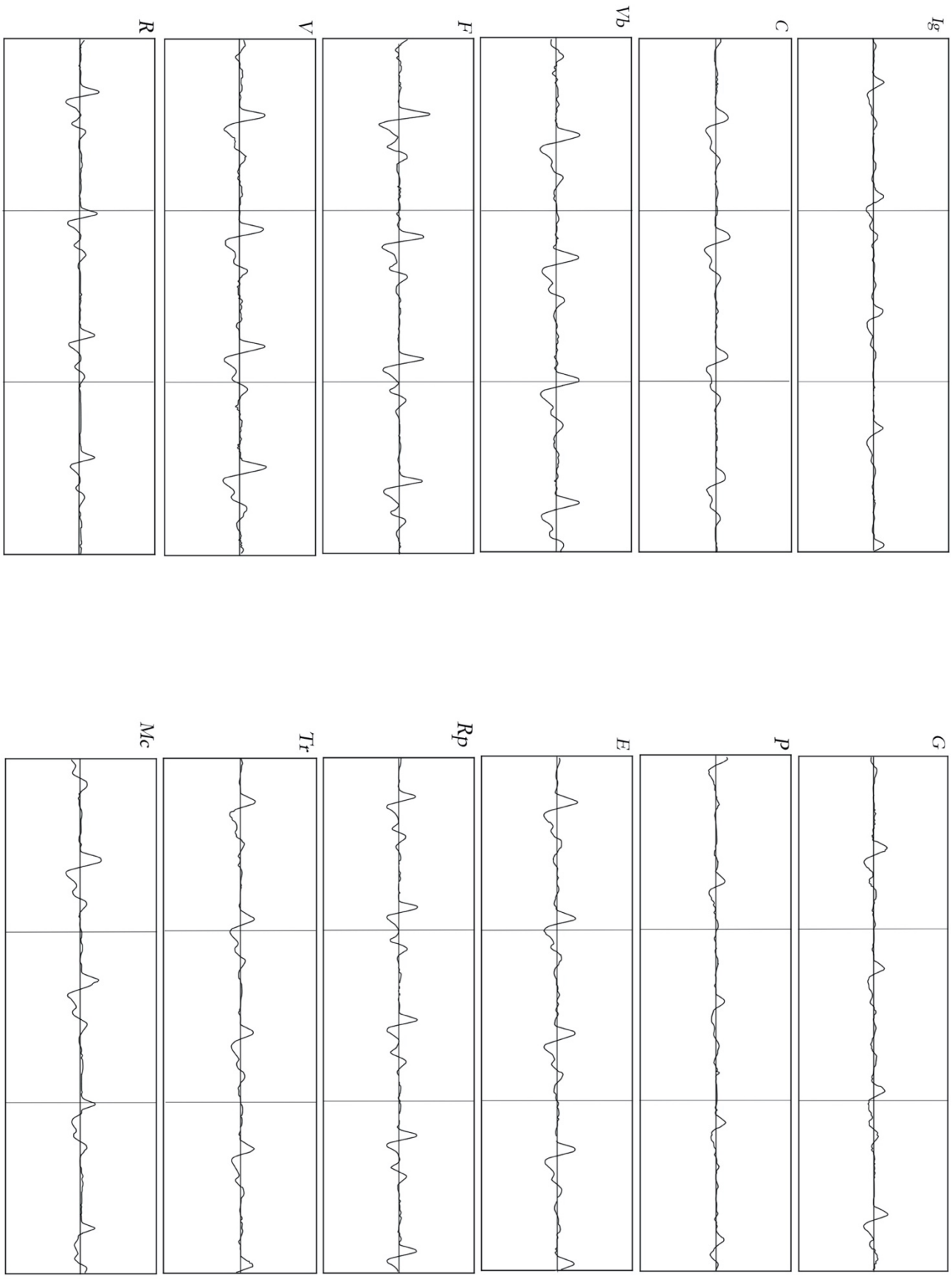


Figure 28. Predicted trend to Liver, Gallbladder and Stomach and Spleen hyperfunction in the background of other remaining functional systems - comparison after treatment: further harmonization of the pulsogram.

CONCLUSION

HPD is a functional diagnostic method. This means that with its help we can directly evaluate only the functional characteristics of the work of human organs and systems. It follows that the APD makes it possible to judge the state of structure and tissues, only on the basis of the laws of structural-functional correspondences. However, a combination of clinical and pulse data for making a full-fledged clinical diagnosis is usually quite sufficient. An illustration of this is the chapter on clinical examples. In this sense, the HPD method is on a par with any other hardware diagnostic method.

The indisputable advantage of HPD is that this method allows you to evaluate the functional state of all major body systems at the same time. Possessing sufficient depth and detail, the HPD makes it possible to analyze the functions of various levels: the organism as a whole, the union of functional systems, a separate functional system, as well as the functional intersystem balance.

At each level we receive various information. At the level of the whole organism, according to the HPD, one can judge:

- about the level of human health,
- on the degree and characteristics of its adaptation to environmental conditions,
- on the effectiveness of human functioning in the physiological, psychological and social sense,
- on the presence or absence of a balance of processes occurring in different functional systems (intersystem homeostasis),
- about the prevailing background emotional state.

At the level of unification of functional systems, we determine:

- the level of functioning power and evaluate the effectiveness of the function of combining systems,
- intersystem balance,
- weak and strong link of association.

At the level of the functional system, the HPD allows you to consider in sufficient detail:

- power and efficiency of the system,
- the current level of adaptive reserves, the ability of the system to accumulate and maintain a functional reserve,
- activity of interstitial metabolism of the system in relation to the conditional norm,
- determine the type of process disturbance in the system: dystrophy or inflammation,
- assess the adequacy of the autonomic nervous regulation of the processes and functions inherent in the functional system, their spatial and temporal synchronization.

All this information together with clinical data makes it possible to deeply and reliably understand the processes occurring in the human body and make a lot of conclusions: either in the form of a clinical diagnosis, or in the form of an expanded description of the functional state of the body, or in the form of a conclusion about the current psychological state and social success of a person.

The scenarios for using HPD in medicine, both therapeutic and prophylactic, are quite obvious. They relate mainly to the assessment of various physiological parameters. The method can be useful in any situations where you need to evaluate a person's condition in the broadest sense. For example, for express assessment of the state of operators, dispatchers, drivers and other groups of people who make key decisions.

Psychology has become a completely new field in the application of pulse diagnostics. General picture of the pulse, if it is considered as a reflection of the total state of a person, makes it possible to answer the following questions with high reliability:

- whether a person is in a balanced state (emotions, psychological reactivity),
- assess the situational and background emotional state of a person,
- see the psychological dynamics in a certain period of time,
- predict the performance of a person as a whole and at high load,
- with a high degree of probability to predict how a person will manifest himself in various situations and types of activities.

Hardware pulsography in personnel management turned out to be a very interesting and new tool. We used it together with the author's method of constitutional typing BIOSOFT (the method relates to somato-psychological diagnostics, does not require the use of psychological tests and was developed by the authors in 2001; patent of Ukraine 60634 A). The combination of these two technologies allows you to quickly, objectively and accurately characterize not only health and psychological characteristics of a person, but also to predict the type of performance and social behavior of a person. The aggregate information allows us to judge the employee's compliance with a particular position and, ultimately, was a sufficient and objective basis for making personnel decisions. Subsequent personnel monitoring showed high reliability of such HR diagnostics. We plan to write more about the use of HPD in the assessment of human resources in the next book.

PROSPECTS

Speaking about the prospects for the development of HPD, we see two main areas. The first of them is the expansion of diagnostic tasks and the field of its application. Given the features of ADF, we believe that its widespread use will be useful in the practice of a family doctor, for the diagnosis of psychosomatic pathology and in the diagnosis of health. In addition, on the basis of the HPD, mobile diagnostic complexes can be created for the work of medical workers in remote and inaccessible areas (geological parties, drilling rigs, ships, etc.). Moreover, in the category of "medical workers" one can safely include not only a doctor, but also specially trained paramedics and even sanitary instructors. Their task may include only taking a pulsogram and transferring a file with a pulsogram and other related information to an advisory center via INTERNET or other communication channels. HPD can be successfully used to diagnose human health (elements of such work are given in the section on working with a team of football players). But, in our opinion, the use of ADF for medical forecasting is particularly promising, in particular with the aim of assessing insurance risks in life and health insurance.

The second direction of development of the ADF is to improve the hardware–software base of the method. There are great growth prospects. In particular, increasing the functional and visualization capabilities of the work program. A very useful function will be, for example, the ability to automatically recognize the teeth of the pulsogram and calculate the parameters of the pulse complexes. The data obtained in this way can be represented in the form of comparative charts, diagrams, graphic images, etc. The possibilities of computer graphics in this regard are very wide.

To the natural question - is it possible to fully automate the interpretation of pulsograms and diagnosis? - our answer is so far negative, since the clinical situation, load and emotional state should be taken into consideration, and therefore, the final conclusions are always made by the doctor.

Separately, it is worth touching on the issue of improving heart rate sensors and the pulse registration procedure. For the sensor itself, we always had two basic, but fundamental requirements. First, the sensors must be accurately calibrated using a standard procedure. With acoustic sensors this is not easy to achieve and there is something to develop and improve. We do not deny the possibility of using new types of sensors. However, the shape of the curve obtained using the microphone sensor is very informative and defacto has become the standard in our technology. Therefore, in the case of using new sensors, it is desirable to obtain an identical curve.

As for the pulse registration procedure, we are supporters of simplified technology, when the sensor is held by the hand of a diagnostician, and not a complex mechanical device. Machines with several sensors and other complex technical solutions are usually called for to accurately dose the degree of pressure of the sensor to the artery and determine the location of the clip. But this way has a number of disadvantages, the smallest of which is the unjustified high cost of such devices and the inconvenience of use.

The patient's pulse recording points are located very individually, and the artery at these points lies at an individual depth. It is almost impossible to take all these points into account and at the same time make the device for registering a pulse convenient. In any case, its complexity according to our data has never justified the results obtained. And why should we invent another bike?! It is enough to recall how many acupuncture point search devices were invented, but the doctor usually does not need them and relies on his experience, sensations, and natural landmarks, which are very individual in patients.

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