A VASCULAR SCREENING TECHNOLOGY

It's a real tool in the fight against cardiovascular diseases.

• Reliable diagnosis, which doctors and patients can understand.
• For a patient – rapid and available information about the cardiovascular system's state.
• For a doctor - quick objectification of processes for decision-making, enhanced customer.
• For health care - independent tool of evidence-based medicine, means for legal support and protection against medical mistakes.

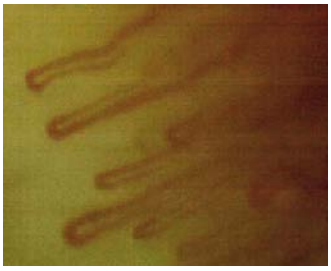
The technology ideologist - a member of the Academy of Technological Sciences of Ukraine, Ulyana Lushchyk, MD

FROM VISUALIZATION OF THE CAPILLARY TO A TECHNOLOGY OF ASSESSMENT OF A VASCULAR PATHOLOGY AND THE RISK PREVENTION

Each new version provides improved resolution and image quality, methodology improvement for application in diagnostic and treatment process.

Disadvantages: old optics, poor visualization, low increase, a lot of artifacts.

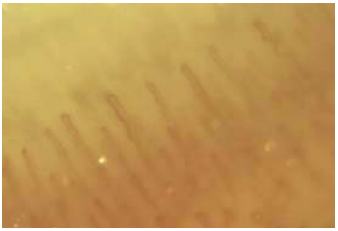
1st version of the device and the example of capillary images, 1999.



Disadvantages: unclear and unstable images do not allow counting capillary parameters.

2nd version of the capillaroscope, 2003

Improved contrast, the quality of visualization, the ability to increase up to 100 times, the ability to observe the speed of blood flow.

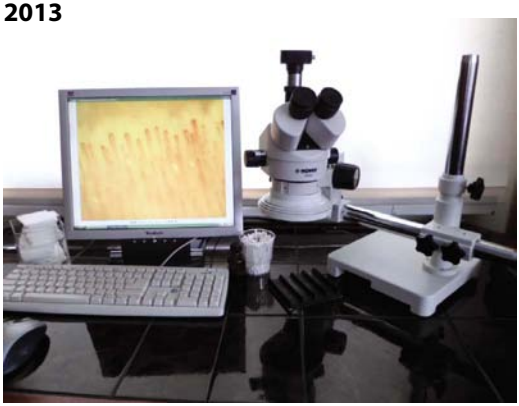


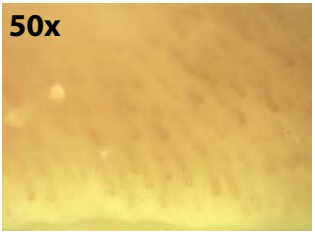
Disadvantages: currently this version is obsolete.

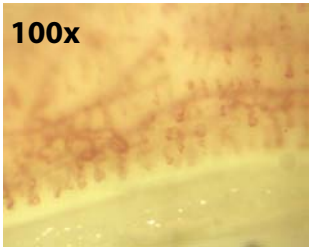
3rd version of the device, 2006.

Improved clarity of visualization of capillaroscopic images, the ability to increase has risen to 300. The obtained images enabled to calculate large number of microcirculation parameters in the semi-automatic mode and managed to gain experience to create a vascular screening technology. Disadvantages: currently this version is obsolete.

2013







Last, 4th version enabled to:

1) significantly improve the quality and clarity at different magnifications;

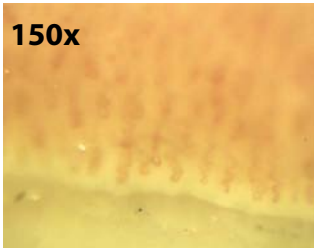
2) increase the dynamic range of the optical zoom from 50 to 400 times;

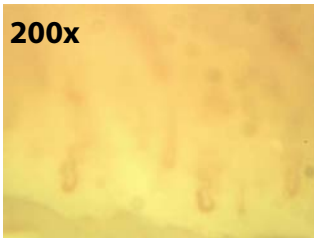
3) apply the automatic processing of static images;

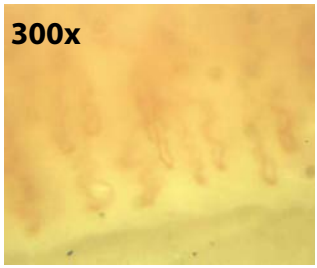
4) create a series of instruments and subtechnologies for different specialists – angio- and cardiosurgeons, oncologists, psychoneurologists, cardiologists, neonatologists and pediatricians, intensive care and rehabilitation specialists, endocrinologists;

5) apply this technology due to contactless technique in dentistry (periodontics), neurosurgery and gynecology;

6) predict vascular risk in insurance medicine, health resorts, pharmaceutical business.

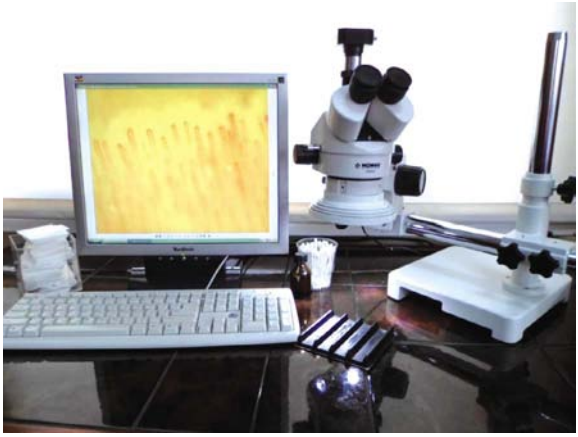






VARIETY OF TECHNICAL MODELS

The vascular screening technology is a unique technology created on the basis of combination of technical components, scientific knowledge of microcirculation and hemodynamics, angioarchitechtonics combined in a single complex.



Stationary device for vascular screening in a unit for functional or vascular diagnostics.

Mobile version (for fielding advice, diagnosis at a patient's bedside in intensive care and operating room).

THE VASCULAR SCREENING TECHNOLOGY "TURNKEY": FROM PROBLEMS' VISUALIZATION TO JOINT DISCUSSION OF ITS SOLVING

KEY BENEFITS OF THE VASCULAR SCREENING TECHNOLOGY:

- high visualization of information for understanding by a patient;

- patients' confidence and visualization of real images allow a doctor and a patient immediately to discuss ways of the problem solving;

- easy to use: diagnosis lasts 5 minutes;

- non-invasive;

- high accuracy;

- bloodless, painless, safe;

- absence of contraindications;

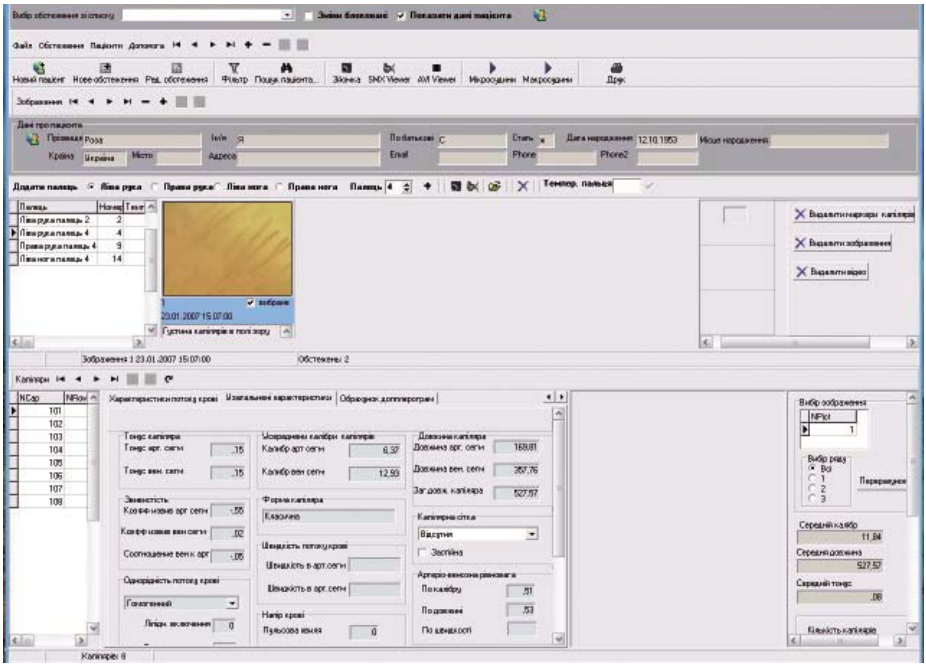
- high quality of imaging both of capillaries and circulation rate.

NEW!

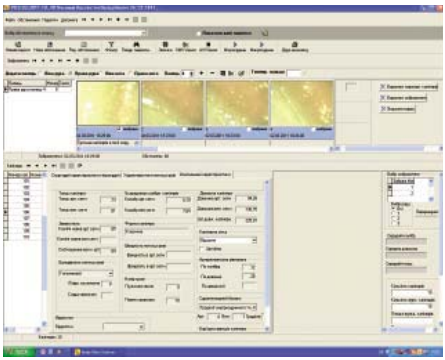
IT component enables to:

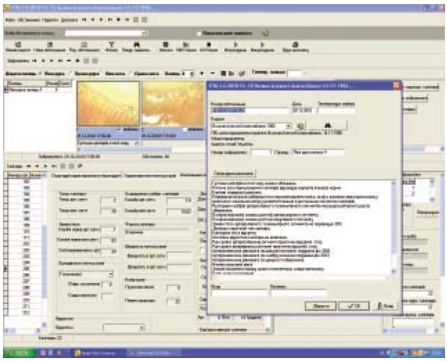
- **visualise problems at various stages of CVD,**
- **make computer analysis of detected disorders and possible risks,**
- **create subtechnologies for making tactic decisions in neonatology, paediatrics, angiology, cardiology, angioneurology, oncology, rehabilitation, balneology, insurance medicine.**

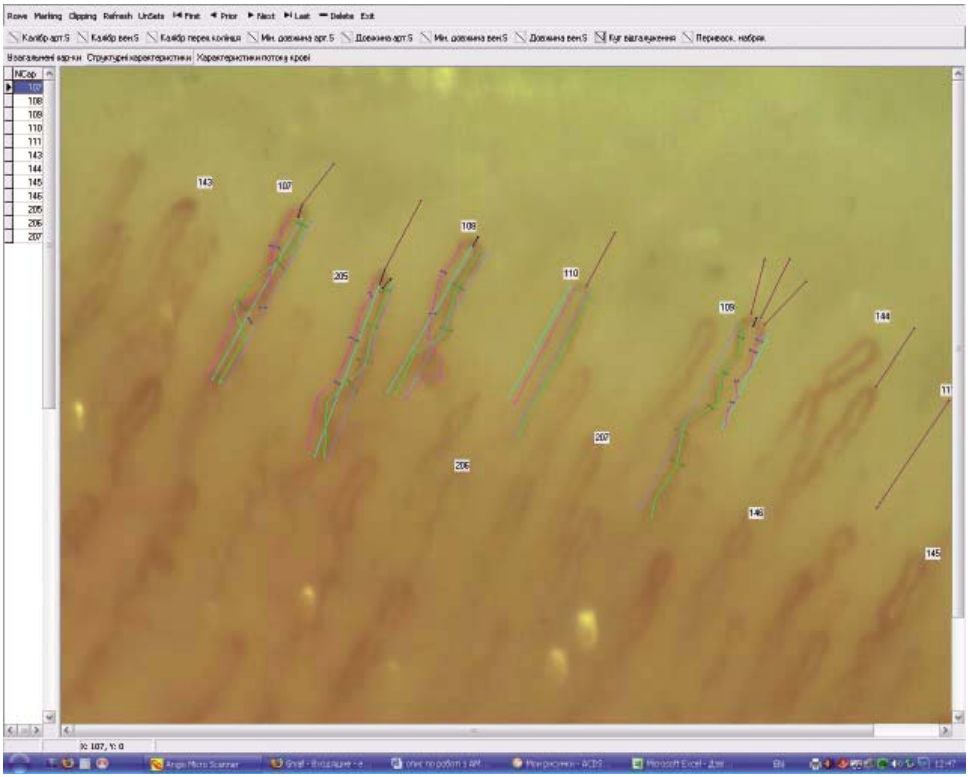
EXAMPLES OF PROGRAM DECODING



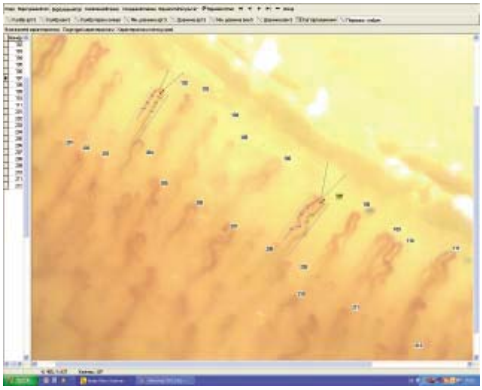
General view of calculating the microcirculation parameters

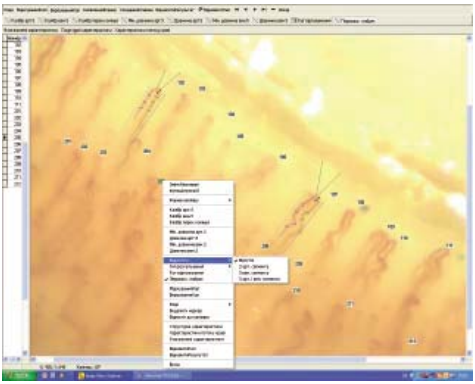






An example of capillaroscopic parameters' calculation





CLINICAL REPORT

THE CLINIC
OF ULYANA LUSHCHYK

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SMART VITAL CAPILLAROSCOPY OF MICROCIRCULATORY CHANNEL ON A NAIL BED

Left hand, finger 4	temp of a finger	date of recording	image 1
Name/surname of a patient	sex	14.06.2010 date of birth	date of examination
Damah Ahmad Al Shamdi	**male**	**11/11/1961**	**14.06.2010**
Address			

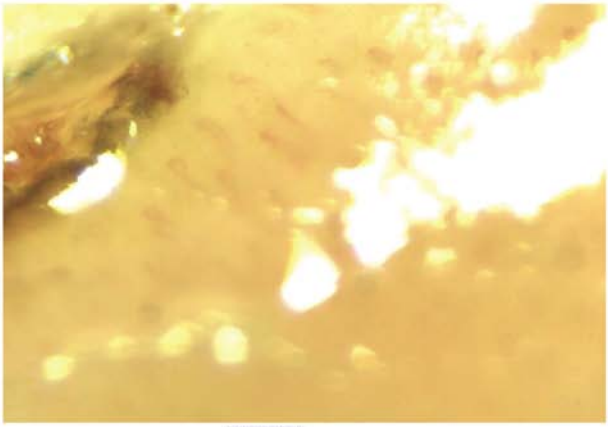
Generalized characteristics of the microcirculatory picture

Characteristics	Value	Description	Norm
Capillary amount	17	The capillary density is sufficient within eyeshot	16-20 capillaries within eyeshot
Amount of the functioning capillaries	14		
Ratio of the functioning capillaries	82,35	The ratio of the functioning capillaries is within the background norm	From 80% to 100% of the functioning capillaries within eyeshot
Caliber of an arteriolar segment	12,16	Large-caliber type of microangioarchitectonics predominates that is a background factor for risk of a chronic decreasing of head of blood supply in distal capillary segments	Arteriolar caliber 3-6
Caliber of a venular segment	10,06	A tendency to dilatation of a lumen in the venular segment of capillary channel with formation of the phenomenon of the venous congestion	Caliber of V and A segments are equal or venular caliber exceeds arteriolar to 30%
Length of an arteriolar segment	102,62		
Length of a venular segment	91,12		
Tonus of an arteriolar segment		Moderately expressed signs of the dystonia of the arteriolar segment	Caliber variability does not exceed 10%
Tonus of a venular segment		Moderately expressed signs of the dystonia of the venular segment	Caliber variability does not exceed 10%
Coefficient of tortuosity of an arteriolar segment	,15		
Coefficient of tortuosity of a venular segment	,37		
Ratio of the real tortuosity of an venular segment to arterial	2,36	Moderately expressed tortuosity of the capillary segments. There is a high risk of hydraulic stroke with capillary structure deformation	Arteriolar and venular segments exceed the perpendicular no more than on 30%
Capillary form	Atypical	Atypical capillary form due to arteriolar segment	Arteriolar and venular segments exceed the perpendicular not more than on 30%
Capillary net	no	Capillary net is absent	Capillary net is absent or corresponds to a patient's age
Shoots	no	Atypical capillary shoots are not found	No shoots
Type of branching	bifurcation		No branching
AV balance by caliber	-,21	Arteriovenous balance by caliber is slightly imbalanced (to 30%)	The magnitude differs no more than on 10%
AV balance by length	-,13	Arteriovenous balance by length is slightly imbalanced (to 30%)	The magnitude differs no more than on 10%
AV balance by velocity	-,25	Arteriovenous balance by velocity is slightly imbalanced (to 30%)	The magnitude differs no more than on 10%
Velocity in an arteriolar segment	10	Velocity in the arteriolar segment is accelerated.	Velocity in the arteriolar segment is from 6 to 10
Velocity in a venular segment	8	Velocity in the venular segment is physiological and sufficient.	Velocity in the venular segment is from 6 to 10
Pulsate wave in an arteriolar segment	0	No pulsate wave	No pulsate wave
Blood head		Blood head is physiological and sufficient	Full blood filling of capillaries.
Homogeneity of blood flow	Homogenous	Blood flow is homogenous	Homogenous
Perivascular edema by size	78,38	Flooding of perivascular tissue is within the norm	No, or less than 80%
Vascular-water balance	A gradient of intravascular pressure	A gradient of intravascular pressure partially broken	Vascular-water balance
Perivascular edema by expressiveness	Expressed round >4-5 capillaries	Perivascular edema is expressed round >4-5 capillaries	Perivascular edema = 0

The program is able to generate clinical output in 4 languages: Ukrainian, Russian, English, German

Image left hand

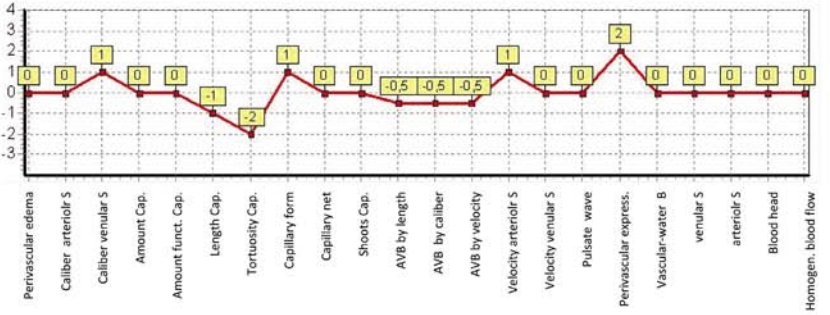
finger 4



Conclusion

The capillary density is sufficient within eyeshot.
The ratio of the functioning capillaries is within the background norm.
Capillaries of the small length – background provoking factor for reduced microcirculation.
Large-caliber type of microangioarchitectonics predominates that is a background factor for risk of a chronic decreasing of head of blood supply in distal capillary segments.
The caliber proportion of arteriolar and venular segments is preserved.
Moderately expressed signs of the dystonia of the arteriolar segment.
Moderately expressed signs of the dystonia of the venular segment.
Arteriolar segment tonus is adequate and physiological. Arteriolar segment tonus is adequate and physiological.
Moderately expressed tortuosity of the capillary segments. There is a high risk of hydraulic stroke with capillary structure deformation Atypical capillary form due to arteriolar segment.
Capillary net is absent. Atypical capillary shoots are not found. Velocity in the arteriolar segment is accelerated.
Velocity in the venular segment is physiological and sufficient.
Arteriovenous balance by caliber is slightly imbalanced (to 30%).
Arteriovenous balance by length is slightly imbalanced (to 30%).
Arteriovenous balance by velocity is slightly imbalanced (to 30%).
No pulsate wave. Blood head is physiological and sufficient. Blood flow is homogenous.
Flooding of perivascular tissue is within the norm.
Perivascular edema is expressed round >4-5 capillaries.

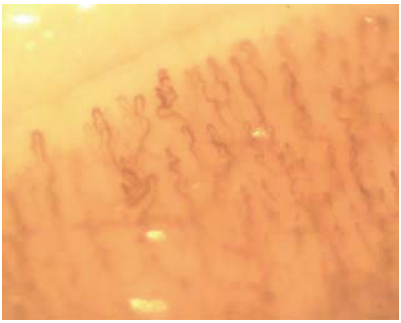
Histogram of relative evaluations of the norm and pathology

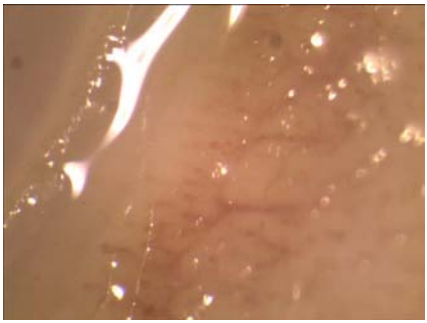


Doctor U.B. Lushchyk, MD

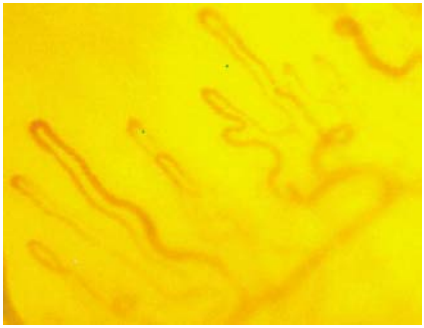
CONGENITAL MALFORMATIONS OF VESSELS

A healthy nation starts with certificated newborns and development and implementation in practice measures elaborated by Ministry of Health for family doctors for early detection of abnormalities - aneurysms, arteriovenous malformations and stroke prevention in children and adolescents.





Irregular formation of vessels in the form of atypical capillaries cause the stroke risk in children and teenagers. The vascular screening technology allows for certification of vessels in infants and for adequate stroke prevention in children and teenagers.

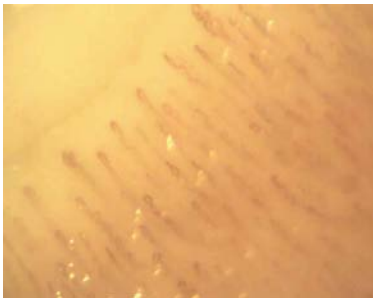


Atypical formation of angioarchitectonics – three-corn capillaries and inadequate venular network of a newborn. High risk of delay in the psycho-physical development and venous bleeding.

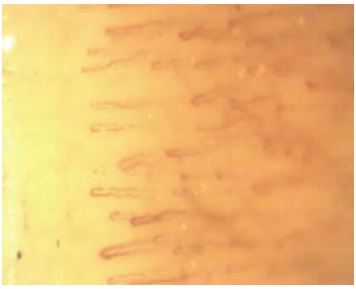
CARDIOLOGY AND CARDIAC SURGERY

Specialists are able to provide the complex diagnostic examination of the smallest element of the cardiovascular system - capillary, which enables to diagnose and develop treatment systems and preventive measures without surgical intervention, if necessary, in cardiac surgery - to quickly assess the effectiveness of the operation into the operating table.
The subtechnology allows monitoring changes in the patient's state at each stage of treatment without complex diagnostic procedures.

The Capillaroscopy method is an arbitrator of welfare of the cardiovascular system in the human body.

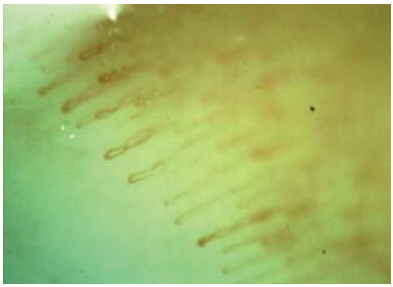


The weakness of capillary blood filling in the background of vegetative-vascular dystonia, hypotension with moderate venous congestion and compensatory vasoconstriction.



Screening signs of cardiovascular disease in the form of sludge phenomenon.

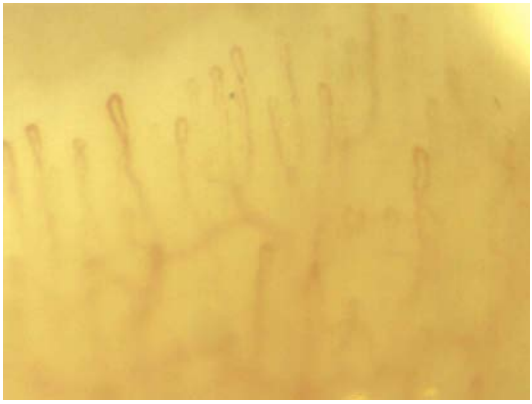
Moderately expresssed signs of blood deficiency on the background of the expressed subdecompensated venous stasis in stretch dilated venous nets and compensatory vasoconstriction with preserved myocardial function after coronary artery bypass grafting.



Expressed signs of imbalance in cardiovascular system, ischemic heart disease, angina pectoris.

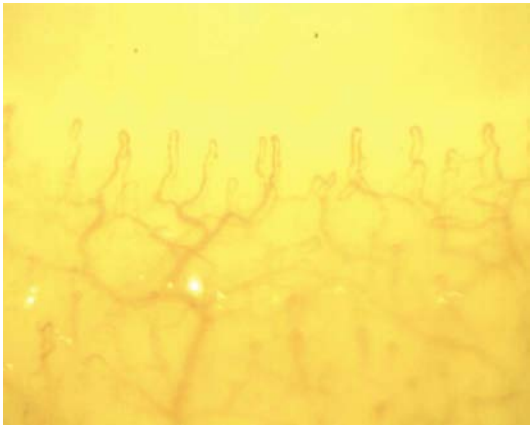
ANGIONEUROLOGY

Today, in the world diseases like stroke and heart attack strike younger population, this leads to increase in the mortality rate on 40% (stroke). And we require some modern diagnostic tools that would allow a comprehensive vision of the problem in a minute, which reduces clinics' budgets for rehabilitation after vascular accidents. The government should focus on prevention of health disorders, and not on their treatment.



Expressed signs of the perfusion decrease in a patient with vascular dementia at the beginning of treatment. In dynamics it was succeeded to improve cognitive sphere on the background of restoration of capillary blood filling.

Severe cardiovascular system imbalance in the patient. Diagnosed condition after suffering extensive ischemic stroke. The picture shows expressed signs of arterial tissue ischemia, the dominance of venous stases with signs of microaggregation in dilated venular nets. High risk of recurrent stroke.



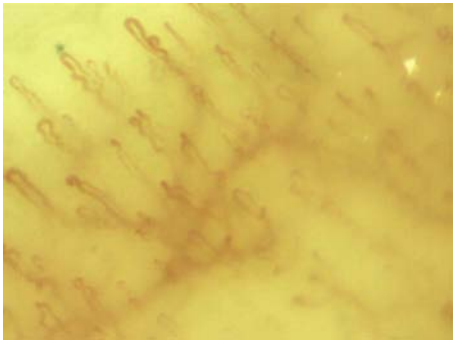
VASCULAR ABNORMALITIES IN PSYCHIATRIC PRACTICE

Currently all employers realize that a mentally stable employee raises its efficiency by 20%. Cerebral circulation disorders are the main cause of worsening of mental state of a person. This leads to asthenia, chronic fatigue syndrome, neuroses, and other border states.

The purpose of this subtechnology - early detection of abnormal conditions of blood vessels.

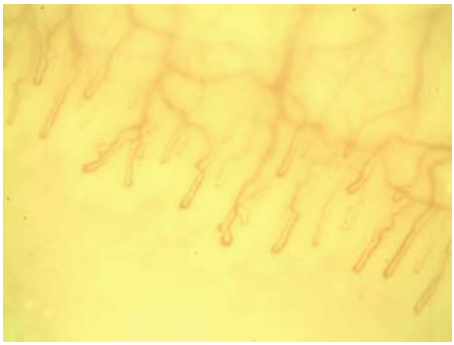
Patients with mental health problems almost does not have any examinations of the vascular system, which would allow to identify congenital or acquired vascular disorders and partially correct them, thereby improving the quality of life of these patients. The positive experience of supervision of patients with psycho-speech disorders, autism, epilepsy allow us to have fresh look at this problem and affirm the importance of a comprehensive cardiovascular diagnosis in psychiatry.

The technology is designed to examine the microcirculation and receive individual assessment of the adequacy of the cortical blood supply to needs of brain tissue.



Atypical type of the capillary angioarchitectonics with numerous spikes leads to a violation of principles of continuous blood supply to the brain of patients with autism and correlated with signs of reducing brain perfusion in the temporal areas (according to PET).

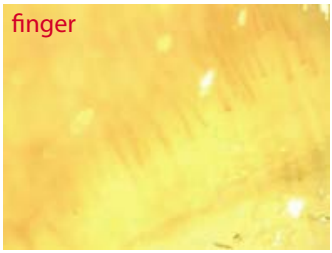
Juvenile type of angioarchitectonics distorted by tree-like bifurcation of venular trunks in a patient with schizo-affective disorder.

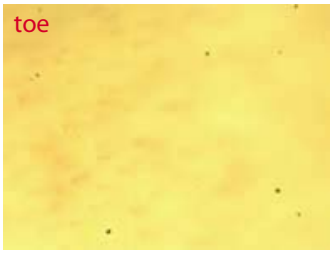


DYNAMIC MONITORING IN ANGIOTHERAPY

Main aspect of this technology is the possibility of obtaining fixation of necessary parameters at all stages of the therapy and enables specialists dynamically to react to results obtained and adjust treatment plans in accordance with patients' needs.
This diagnostic subtechnology provides significant benefits to health care units that use it.
There is an example of the successful treatment of disorders in microcirculation under control of the smart capillaroscopy in a patient X, 63 years old, with complaints to polymorphic pains in his lower extremities, sensation of cold in his legs, complaints to sensation of his foots freezing even in summer. According to his anamnesis – he has been suffering from the continuous form of the bradycardiac atrial fibrillation, the atrial fibrillation, arterial hypertension for the last 7 years.
Main vessels – signs of decreasing of the pumping function of the myocardium, moderately expressed venous congestion, sharp decreasing of the blood pressure in the proximal segments of the main arteries in his hip.
Taking into account peculiarities of functioning of the myocardium the decision was made about vasoactive correction of the hemodynamic parameters with double purpose:
1. As much as possible to recover the level of microcirculatory perfusion and to stabilize the obtained results.
2. Within the protective regimen to improve parameters of the pumping function of the myocardium preventing increasing of the myocardium ischemization's signs.

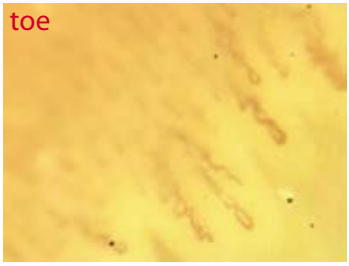
Since the capillaries are the final link in the blood supply in the cardiovascular system, monitoring of changes and sanogenic restructuring is quite important for monitoring the treatment effectiveness and it is an element of evidence-based medicine in the individually oriented treatment.



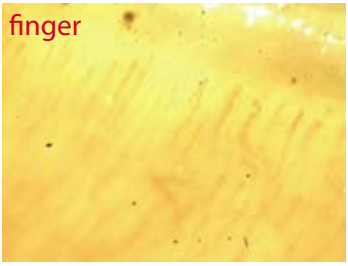


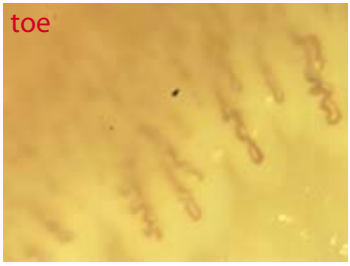
1st day. Improved blood filling in capillaries in the fingers, in the capillaries of the toes - the first signs of blood filling.

5th day. The blood filling of capillaries is sufficient in the fingers; the area of the perivascular edema is decreasing. Visualization of abnormal very tortuous capillaries in the toes, the expressed stagnation in the venular segment.

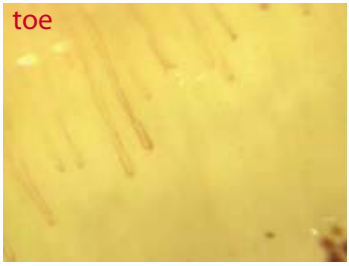


10th day. There is a leveling of the capillaroscopic picture in the fingers and toes. On the foreground there is a tortuosity of capillaries, the expressed perivascular edema in legs. The velocity of blood flow is sufficient.





15th day. The sufficient blood filling of capillaries in the fingers. There are angiospastic reactions in arterioles on the background of the expressed venous congestions in the toes.

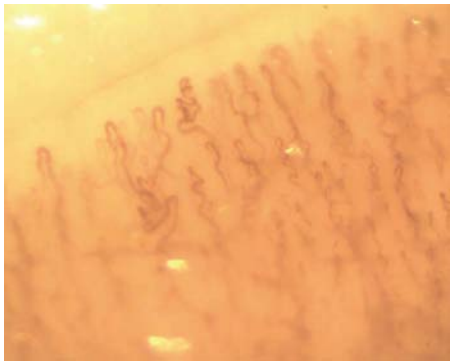


In 5 days after completion of injections. The presence of blood filling of capillaries in fingers and considerable improvement of visualization of capillaries in toes, sufficient velocity and caliber of capillaries testify for improvement of the microcirculation level and partial stabilization of the achieved results of treatment in spite of significant problems in the systemic hemodynamics.

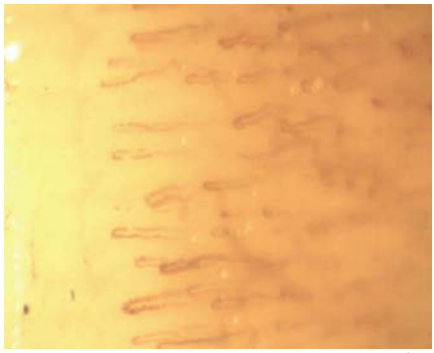
In the dynamics of the treatment it was succeeded to improve the quality of life, to reduce discomfort in the legs and to normalize the body temperature.

VASCULAR MONITORING IN REHABILITOLOGY AND BALNEOLOGY

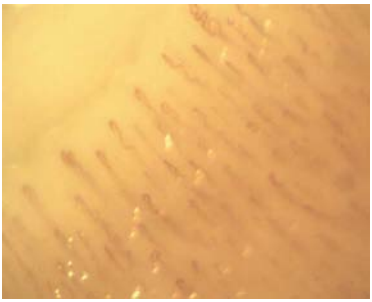
This subtechnology enables to visualize and record the patient's condition at the "entrance to the facility," in the course of treatment, and at discharge. An important aspect of health resorts is to identify risks of vascular accidents at the start of spa treatments. This may be like an evidence for protection of the sanatorium, spa and rehabilitation center. Also, it can be widely used to study the dysfunction of the vascular system with a subjective sensation of discomfort in order to reduce risk prior to the various treatments. Thanks to this technology in the spa and rehab treatments the patient can observe positive changes owing to the recreational therapy. At the end of treatment, the patient receives a clear picture of what real qualitative changes have occurred during rehabilitation.



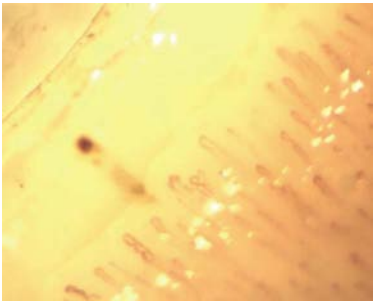
A stage of preparation to some group activity in a preschool establishment became possible due to the circulation improvement and strengthening of cognitive functions (Yana M., born in 2001; diagnosis: autism, arrest of psychomotor development).



Psychokinesitherapy helps to restore sanogenic reactions of the vascular system to psychological and physical loadings, to prepare the vascular system to the body verticalization of the patient after long staying in bed (Oleksander F., born in 1977; diagnosis: apallic syndrome, stage of "large" (full) consciousness, 1st degree of disability).



Kinesitherapy at the stage of destruction of psychogenic factors of the disease (Vladimir S., born in 1985; diagnosis: epilepsy).

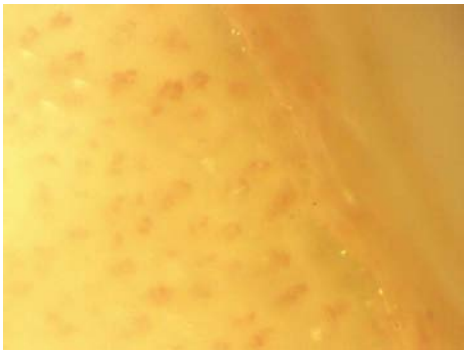


The background worsening of the capillary blood filling can be compensated by kinesitherapy (Mary M., born in 1951; diagnosis: cortical-subcortical brain degeneration).

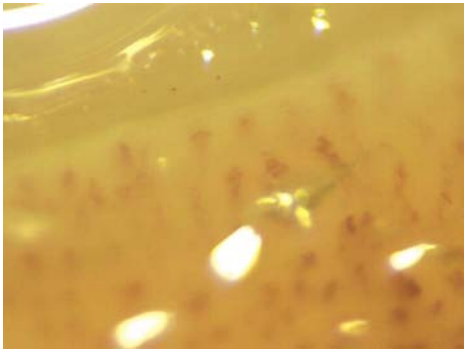
Interchanging of various neurorehabilitation exercises takes into account a level of blood filling and the brain readiness to loads (Galya K., born in 1989, diagnosis: apallic syndrome, the stage of "high" full consciousness, 1st degree of disability).

ENDOCRINOLOGY

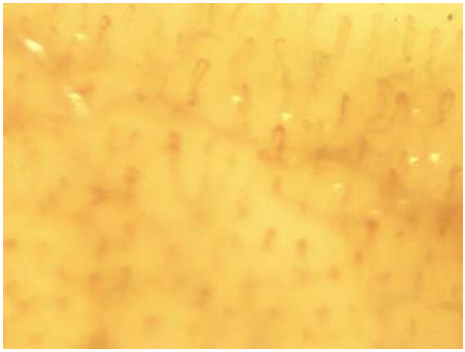
Endocrinology problems are closely related to cardiology, oncology, ophthalmology, and other areas; this stipulates application of innovative approaches to diagnosis of a patient's condition, namely human organism as integrated diagnostic object. This subtechnology enables to examine more carefully the system dysfunction of the respective glands and to differentiate hypophysar intersystem disorders ranging from local disorders in endocrine organs.



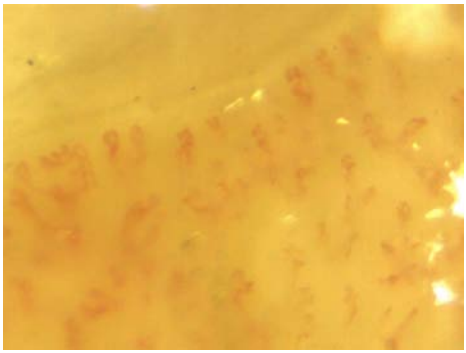
Specific patterns in thyroid cancer.



Diencephalic syndrome



Pathological alteration of the microcirculation on the background of menopausal disorders. Fibroma uteri.



Menopause

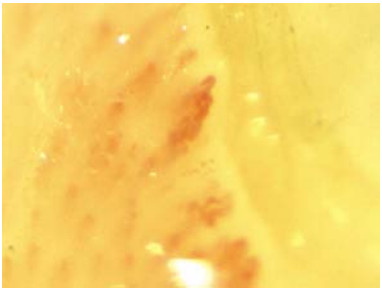
ONCO-CAPILLARIES

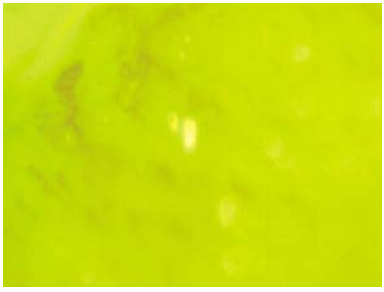
This technology allows diagnosing onco-diseases in the early stages and can be the basis of state compliance program for early detection of cancer. The diagnostic system can be considered by the Ministry of Health to address the problems of oncology and specialized clinics for the cancer treatment.

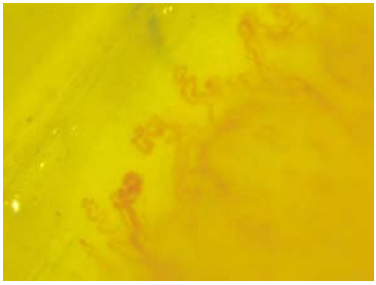
The subtechnology offers an innovative approach to the cancer diagnosis and, importantly, it is an effective tool in the future monitoring of the patient and the disease at different stages of cancer pathology.

This technology can form the basis of modern electronic system for monitoring medical examination of cancer patients and their treatment patterns.
The government can obtain an effective tool for the prevention and treatment of cancer.

Pathological angiogenesis is the basis for the tumor development. Timely detection of uncontrolled processes of hypervascularisation can significantly improve the patient's condition.

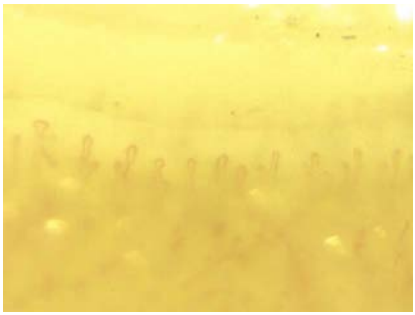






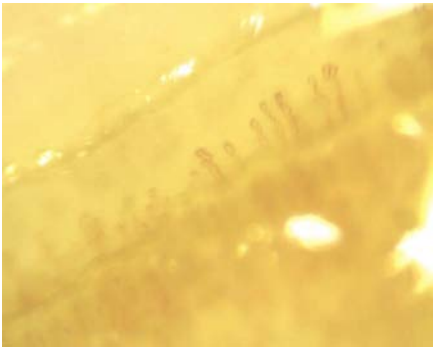
FOR DENTISTRY

Nowadays, the society pays much more attention to prevention of dental disease than to treatment. Actually this subtechnology is created for timely and complete diagnosis of microcirculation in gums, which allows specialists to develop individual programs for prevention and medical treatment of periodontitis and periodontal disease.

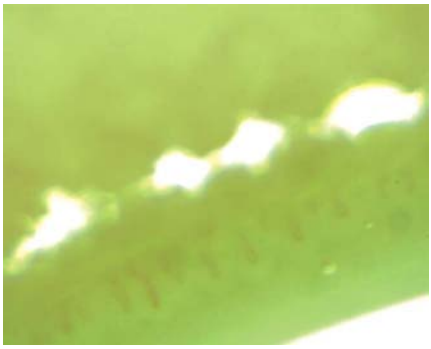


FOR PHARMACOLOGY

This subtechnology allows getting the visualized assessment of the patient's state before vascular treatment and after its completion, which confirm the effectiveness of medicines.



Diagnosis: vasoneurosis of the sympathoadrenal type.
Before the treatment.

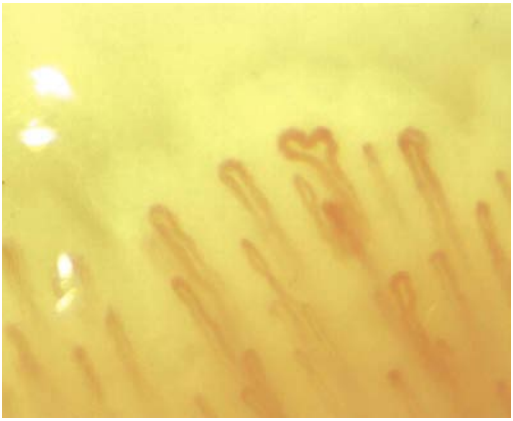


Diagnosis: vasoneurosis of the sympathoadrenal type.
After the treatment.

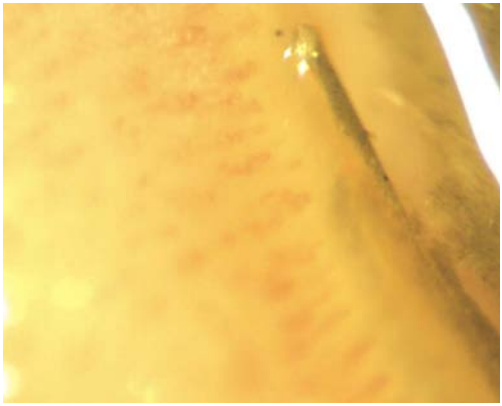
FOR INSURANCE

Today life insurance is one of the hardest segments in the insurance industry, which is caused by high-risk because of lack of an objective assessment of the insured.

This subtechnology allows for an integrated assessment of the adequacy and functioning of the basics of life activity of the body, namely the cardiovascular system.
This subtechnology in the screening mode makes it possible to assess risks of vascular events and predict possible insurance claims.



Slight risk of vascular crises.



High risk of vascular catastrophes as well as the organ pathology.

SCREENING OF ISCHEMIC CHANGES IN THE MYOCARDIUM AND HEART RATE VARIABILITY: HIGH-SENSITIVE ECG

"Cardiovisor-06C" system for rapid heart diagnosis applies a unique method of noninvasive express control (less than a minute without undressing the patient) of the heart functional state, it is based on the latest computer technology and 3D-visualization "of portraits of the heart" by analyzing electromagnetic radiation of myocardium by low-amplitude fluctuations on the standard ECG, registered on the limb leads.

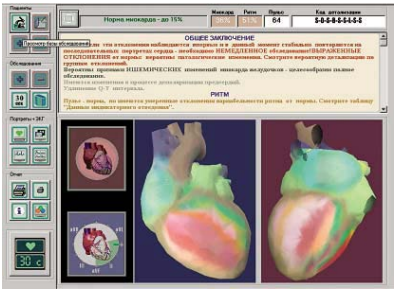
The device for screening - rapid, reliable, easy in use, portable, accessible, high informative.

The complex:

• **provides** early detection, which is especially important, of pathological changes in coronary heart disease, hypertension, cardiomyopathy, valvular disease, intoxication and other diseases;

• **presents** the examination results both in the form easy to understand - as a visual "portrait of the heart", and the set of classic ECG parameters;

• **enables** to conduct screening-estimation of the probable occurrence of myocardial ischemia by nurses. Localization of disorders, which is shown in red, is the basis for in-depth study;



• **provides a new level** of sensitivity, unattainable for conventional ECG analysis. Traditional ECG's sensitivity is approximately 65%, and specificity - 63%. **The "Cardiovisor-06C"'s sensitivity is 79%, specificity – 76%.**

The "Cardiovisor-06C" application:

• cardiology;

• critical care medicine;

• clinical medicine (general assessment of the heart , the therapy selection , early identification of patients with disorders in the heart functioning);

• preventive medicine (screening tests for early and reliable detection of risk for coronary heart disease, heart attack, at the preclinical stage);

• departmental medicine (medical examination);

• first-aid post at institutions;

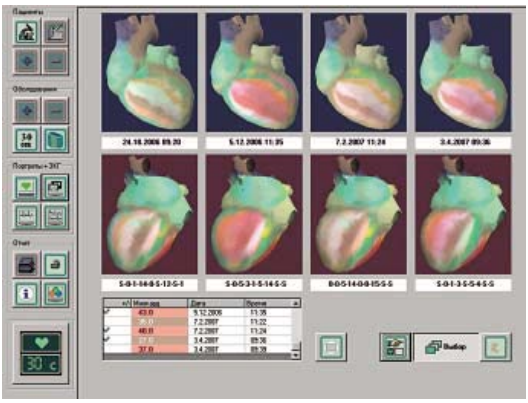
• sanatoriums, rehabilitation centers (objectively express-indicating the heart status and the whole body as well);

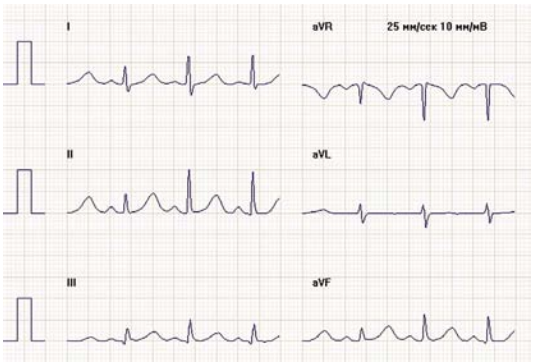
• emergency medical care;

• medicine of catastrophes;

• sports medicine;

• aviation, space and sea medicine.





EVALUATION OF THE ADEQUACY OF THE VASCULAR CHANNEL FUNCTIONING

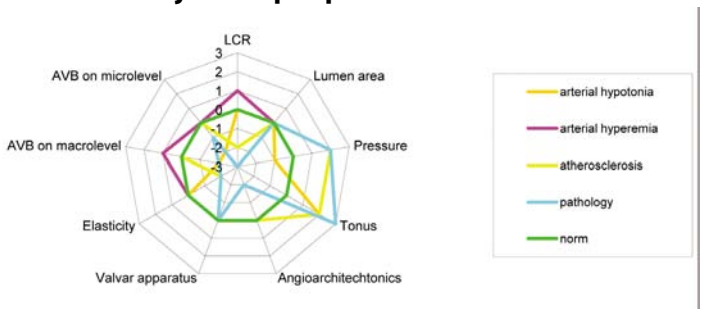
For a successful application of the USDG methodology doctor should have deep knowledge of the anatomy and physiology of the human vascular system, basic knowledge of hydrodynamics and hemodynamics, physics of the ultrasound, characteristics of blood flow as a non-Newtonian liquid.

The methodology essence is in the comprehensive consideration of the blood system as the integral system of the closed arteriovenous-capillary tubing - with its resistance, elasticity of the vascular wall, vascular tone, hydrophilicity of the surrounding tissues.

Up-to-date high-sensitive equipment enables to work both with arterial and venous segments simultaneously, and specially designed software can calculate how significant deviations in a patient from the condition of the arteriovenous balance in the direction to unjustified arterial hyperemia or venous stasis of any degree.

Today, this technique is urgently necessary not only for functional and ultrasound diagnostics, it is relevant to many areas of medicine, such as paediatrics, neonatology, neurology, psychiatry, urology, gynecology and obstetrics, oncology, cardiology, surgery.

Only inexperienced physician allows himself to ignore the results of the doppler studies of the major and peripheral vessels.



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