

Computer diagnosis in cardiology

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Abstract

This article reports upon the emergence of a novel cognitive, computer-based technology which may lead to significantly improved methods of cardiological diagnosis and a rapid and inexpensive method of cardiological screening.

The technology 'Virtual Scanning' illustrates how, in blood, the reaction of proteins and their reactive substrates releases light; that the colour and intensity of this bioluminescence is unique to each reaction and its rate; and that the development of pathologies influence cognition and visual perception. This illustrates that the function of the autonomic nervous system is linked to that of the physiological systems and that the rate of biochemical reactions, and the progression of disease, can be measured by a cognitive test procedure and used as an indication of the disease(s) affecting heart function.

The article discusses the limitations of the conventional biomarker technique, and the potential value of non-invasive cognitive techniques, such as Virtual Scanning, to the medical practitioner. Finally, it discusses how the ability of Virtual Scanning to diagnose disease from its presymptomatic origins may lead to improved diagnostic accuracy and significantly reduced costs.

Keywords: Computer diagnosis, autonomic nervous system, visual perception, virtual scanning, mathematical modeling, physiological systems.

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Introduction

The body reacts with various environmental influences which can be used with diagnostic effect e.g. heat (in thermography), X-rays (in radiography and cat scans), ultrasound, MRI, etc. Thermography produces a scan of the heat released by the body's biochemical processes; MRI uses an understanding of molecular polarity or resonance to assemble a scan illustrating the flow of brain fluids; Ultrasound highlights body structures (tendons, muscles, joints, vessels and internal organs) to establish abnormal growth or damage; and X-rays are used to highlight anomalies affecting bone structure, dense tissues e.g. breakages, damage or tumours. Each technique is

based upon the nature of the interaction between the environmental and/or electromagnetic influence and the body's function. They have been adapted with diagnostic effect.

Of these X-rays are widely used in cardiological diagnosis e.g. X-Ray Cardiology, Coronary Angiography, X-Ray Computed Tomography. Ultrasound is used in echocardiograms and constitutes the majority of noninvasive cardiac testing [1].

Such technologies have inherent limitations affecting the scope of the data derived e.g. the inherent limitations of

the techniques (including the inability to reliably differentiate between benign and malignant tumours [2], that conditions e.g. cancers [3] may naturally remiss, accuracy [4,5] and reproducibility [4]), false positives and false negatives [6,7], the dangers and side-effects associated with the technique. Heightened exposure to X-rays increases the likelihood of creating cancer (1) in normal patients [8-15] and (2) in those who are genetically predisposed or are especially vulnerable [16-19]. The conventional option for diagnosing health is by assessing biochemical dysfunction e.g. histological analysis of tissue samples or the quantitative assessment of proteins in blood samples, however there may also be significant limitations and risk associated with such techniques [20].

The use of cognition as a diagnostic principle

The recognition of visual events, through the perception of colours and visual contrast, comprises circa 85% of sense perception. It influences all aspects of our function ranging from the most subtle experiences to the most extreme stress-related experiences. There is evidence that cognitive deficits [21-24], in particular those associated with colour perception, are not related to a problem with eye function but are instead influenced by pathology [26] i.e. they are not linked to morphological changes in the retina but are instead linked to the function of the autonomic nervous system. This affects the neurovisual pathways which influence (1) colour perception and (2) visual contrast, and is expressed as follows (Fig. 1):

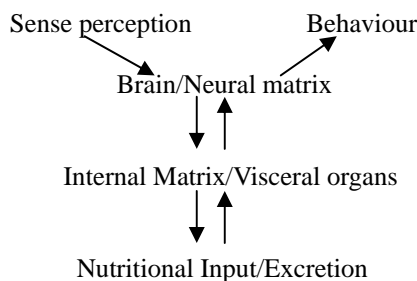


Fig. 1 The flow of Data between the external and internal environments

This contrasts with the currently accepted explanation for sight and visual perception - which is based upon the number and type of colour-sensitive cones and the role of photopsins in the retina however such a hypothesis does not explain how the number of colour-sensitive retinal cones may differ significantly and yet colour perception is unaltered [25]. This suggests that colour perception and visual contrast is influenced by the synergistic function of brain and eye i.e. involving the magno and parvo – cellular neurovisual pathways, which are linked to the autonomic nervous system.

Such observations may be explained if brain function is associated with the autonomic nervous system [26] and subsequent regulation of the body’s physiological systems, organs, cells and molecular biochemistry; and that this is

intimately associated with cognition and, in particular with visual perception [26]. Changes to the levels of proteins and their reactive substrates [26] influence the release of biophotons [27] and hence the intensity and colour of the light released (Fig. 2). This affects visual perception which can be measured i.e. the levels and rate of reaction of chemical processes in the blood can be monitored by measuring the bioluminescence emitted by their reaction.

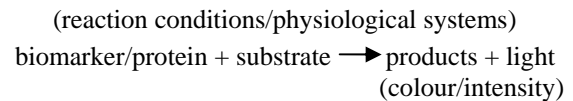


Fig. 2 The effect of the physiological systems upon reaction kinetics

Many commonly observed visual perception deficits are associated with disease states and hence with altered biochemistry (e.g. a blue-yellow colour deficiency is associated with diabetes; a green deficiency with heart conditions; a yellow deficiency with jaundice; migraines and epilepsy can be induced by colours and/or flashing lights) including drug-induced dyschromatopia. There is a clear link between pathology and visual perception i.e. that the quality of blood influences the function of visceral organs AND sensory organs.

The stability of the physiological systems affects the concentration of proteins and their reactive substrates. It influences the reaction conditions surrounding each chemical process. Similarly the function of the digestive system has an effect upon extraction and hence the absorption of nutrients (Table 1 & 2).

Table 1 A summary of the Physiological Systems

Sleeping	Blood pressure	Blood volume	Blood glucose
Breathing	Blood cell content	Osmotic pressure	Digestion
pH	Sexual function	Temperature	Posture & locomotion
Excretion			

Origin: Grakov IG.

Table 2 Typical structures of the Physiological Systems

System which maintains optimal level of blood pressure	Brain, pituitary gland, thyroid gland, adrenal glands, blood and peripheral blood vessels, liver, heart, and spleen.
System which maintains optimal breathing levels	Brain, pituitary gland, thyroid gland, adrenal glands, blood and peripheral blood vessels, nose, lungs and bronchi, heart, skin, small intestine, and kidneys.
System which sustains optimal pH level	Brain, pituitary gland, thyroid gland, adrenal glands, blood and peripheral blood vessels, liver, lungs and bronchi, pancreas, skin, stomach, duodenum, kidneys, small intestine, and large intestine.

The primary techniques used in medical diagnosis relate health to the levels of biochemical marker(s) however the body is a dynamic system in which reaction kinetics are affected by the reaction conditions. This influences the levels of proteins, their substrates and the rates at which they react. As a result the biomarker approach may have inherent limitations e.g. (1) the diagnosed levels may be abnormal and yet the person may be healthy (a false positive); (2) the diagnosed levels may be normal and the person may be suffering from disease (a false negative); or (3) the body's systems might compensate when disease is at or beyond the presymptomatic stage (positive but without symptoms).

The biomarker approach does not take into account that there are stages of disease e.g. (1) presymptomatic; (2) the body system starts to fail; (3) compensation for the effects of the pathology; (4) the development of stable pathology and chronic symptoms; and perhaps also (5) re-invigoration of the body's compensatory processes; and (6) the re-establishment of physiological stability. It assumes that one single biochemical process and biomarker can be used to diagnose disease whilst ignoring that many diseases have multi-systemic origins.

The use of a non-invasive cognitive test procedure avoids the need for blood samples and the errors which subsequently arise due, for example, to the sampling process, degradation of samples [28], errors in the test procedures, operator error, etc. It eliminates the problems associated with blood sampling i.e. the time taken by nurses to take samples, the damage caused by the process of inserting the needle into tissues, and the possibility of contamination, infections, etc.

Cognitive deficits are a noted side-effect of heart conditions [33-36].

Virtual Scanning - test procedure

This computer-based cognitive test is based upon restoring the colours of an image on a PC.

1. The patient is required to study the contents of a picture or video for 15 seconds – and to memorise the colours.
2. After 15 seconds a colour filter appears which masks the original colours. The patient is required to restore the original colours by adding or subtracting colours (red, yellow, green and blue), selected by computer mouse, from the colour palette. When the patient is no longer able to improve the reproduction, and feels that they have completed the task, they press the 'finish' button.
3. This process is repeated several times with different pictures and different colour filters.

This enables the programme to collect data reflecting the patient's abilities re colour reproduction, motor control and memory. The unique mathematics and software of the programme process the data into the health report in a level of sophistication and detail. This is the process

developed by Grakov I.G [26, 33], which is based upon the mathematical modelling of the consequences of cognition (including visual perception) upon the autonomic nervous system and physiological systems.

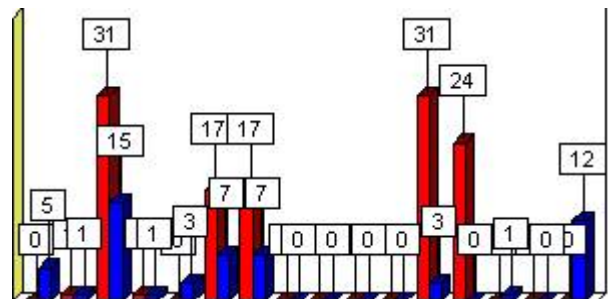
Virtual Scanning – example reports

Virtual Scanning [29-31] is a unique medical concept with an unprecedented capability in the diagnosis of disease. It provides a full diagnosis of every physiological system and organ. The condition of each organ being defined in precise medical terms including conditions which cannot be satisfactorily diagnosed by conventional procedures. It enables the assessment of the function of other related organs which affect the function of the organ under investigation e.g. the action of the adrenal gland upon heart function.

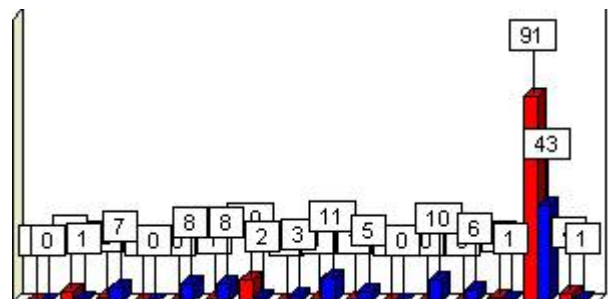
Each diagnosis of a medical condition comprises two numbers which are reported as blue (compensatory)/red (pathology) signal. The Scale: 0-10, presymptomatic; above 10 units symptomatic. The greater the numbers the increased degree of severity. Scale: typically 0-100.

Examples (A-C) of diagnosis:

Examples (A-C) illustrate how this technique can be used as a rapid and inexpensive means of cardiovascular imaging to diagnose cardiovascular disease. Example (D) is included to illustrate the broader scope of the technology i.e. to identify the influence of other organs upon heart function.

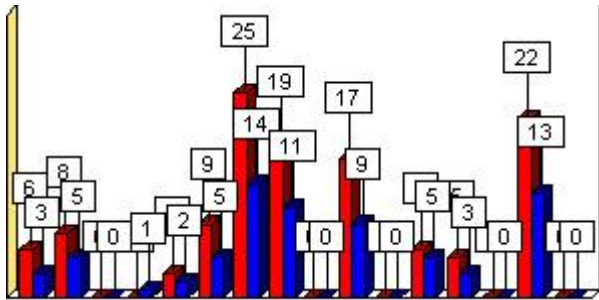


(A) woman, 53 years, 52 kg, HEART diagnosis
 15/31 Angina Pectoris: Expressed pathology signal; 7/17
 Cardiosclerosis: Expressed pathology signal; 7/17 Chronic
 Fatigue: Expressed pathology signal; 3/31 Cardiac
 Insufficiency: Expressed pathology signal; 0/24 Cardiac
 Myopathy: Expressed pathology signal; 5/0 Ischemic
 Heart Disease: Compensatory signal;



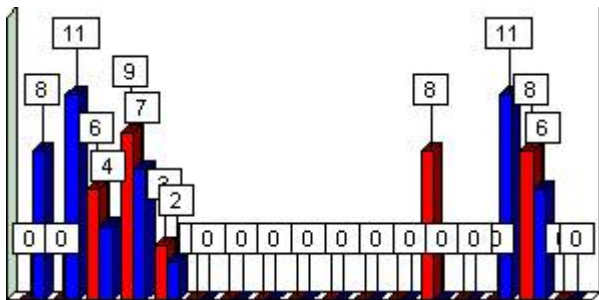
(B) man, 88 years, 77 kg, HEART diagnosis
 Functional Changes: Pathology signal; Chronic Fatigue:

Expressed pathology signal; 43/91 Impairment of Cardiac Rhythm and Conduction: Expressed pathology signal; Tension of compensatory abilities.

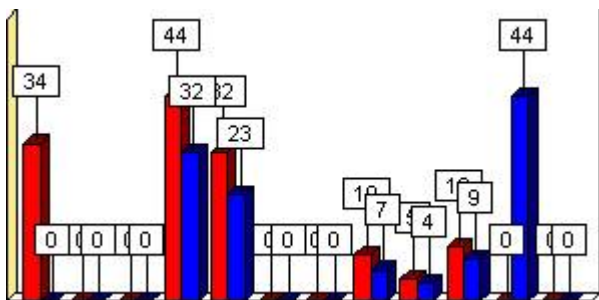


(C) man, 64 years, 70 kg, HEART diagnosis
 3/6 ischaemic heart disease: expressed compensatory signal;
 5/9 cardiosclerosis: expressed compensatory signal;
 14/25 chronic fatigue: expressed compensatory signal;
 11/19 myocardial dystrophy: expressed compensatory signal;
 9/17 myocarditis: expressed compensatory signal;
 5/6 cardiac insufficiency: expressed compensatory signal;
 3/5 cardiac Myopathy: expressed compensatory signal;
 13/22 impaired cardiac rhythm & conduction: expressed compensatory signal.

(D) Example of a complete health report: woman, 41 years, 64 kg

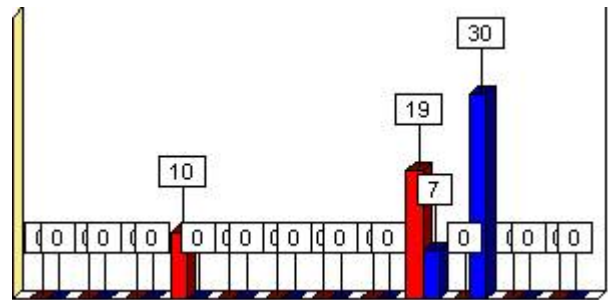


BRAIN
 Degenerative Process: Weakening of compensatory abilities.
 Arachnoiditis: Weakening of compensatory abilities.
 Epilepsy: Pathology signal.
 Vertebral Artery Syndrome: Weakening of compensatory abilities.
 Encephalitis: Compensatory signal.
 Abnormalities of Development: Expressed compensatory signal.
 Migraine: Expressed compensatory signal.

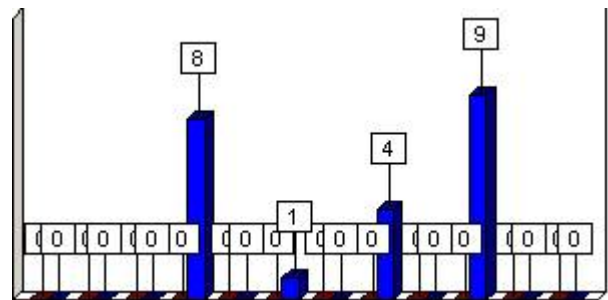


SPINAL CORD
 General weakening of compensatory abilities.

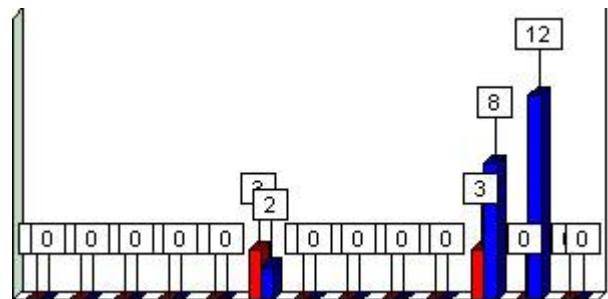
Intoxication Effects: Expressed compensatory signal.



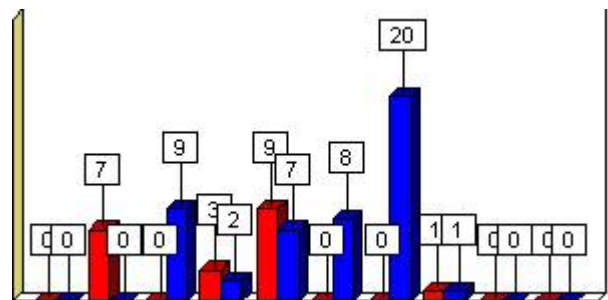
PERIPHERAL NERVOUS SYSTEM
 Spinal Osteochondrosis with Neurological Effects: Pathology signal.
 Age-Related Changes: Expressed pathology signal.
 Radiculitis: Expressed compensatory signal.



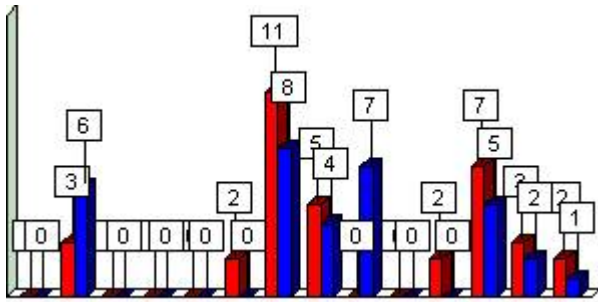
EAR
 Degenerative Process: Compensatory signal.
 Chronic Fatigue: Compensatory signal.



NOSE
 Degenerative Process: Compensatory signal.
 Functional Changes: Compensatory signal.



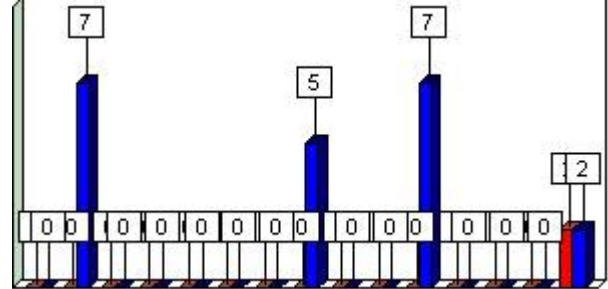
PITUITARY GLAND
 Abnormalities of Development: Weakening of compensatory abilities.
 Neoplasm: Compensatory signal.
 Intoxication Effects: Compensatory signal.
 Post-Stress Effects: Expressed compensatory signal.



THYROID GLAND

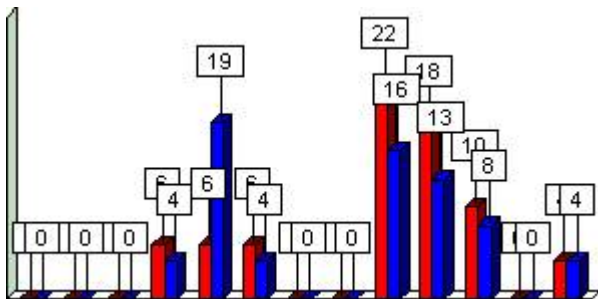
Hypothyroidism: Weakening of compensatory abilities.
 Hypoparathyroidism: Weakening of compensatory abilities.
 Degenerative Process: Compensatory signal.
 Intoxication Effects: Compensatory signal.

Chronic Fatigue: Expressed compensatory signal.



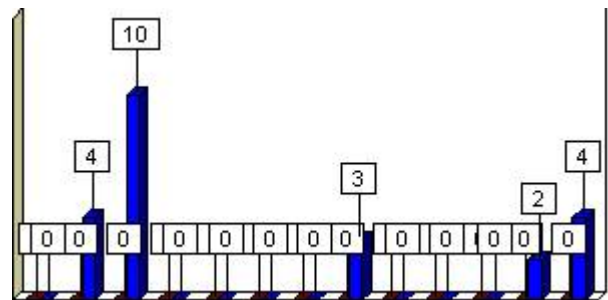
LIVER

Age-Related Changes: Compensatory signal.
 Functional Changes: Compensatory signal.



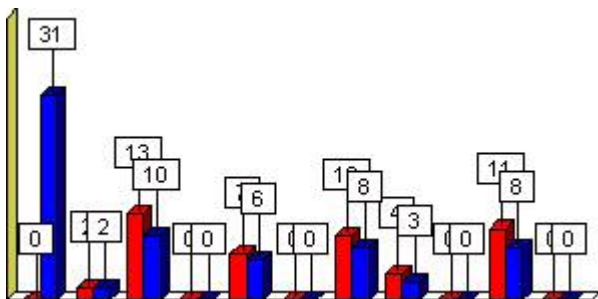
ADRENAL GLANDS

Tissue Growth: Weakening of compensatory abilities.
 Cushing Syndrome: Weakening of compensatory abilities.
 Neoplasm: Weakening of compensatory abilities.
 Degenerative Process: Expressed compensatory signal.



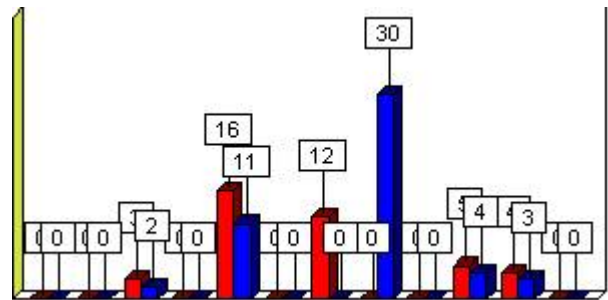
GALL BLADDER

Post-Stress Effects: Compensatory signal.



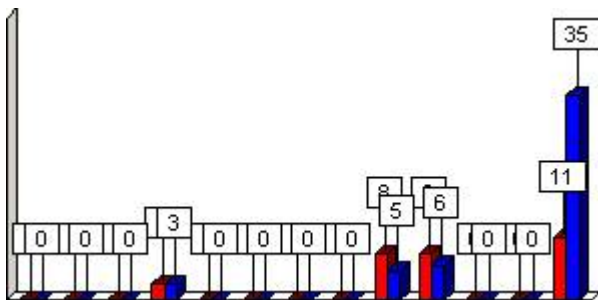
OVARIES

Post-Stress Effects: Weakening of compensatory abilities.
 Age-Related Changes: Weakening of compensatory abilities.
 Functional Changes: Weakening of compensatory abilities.
 Chronic Fatigue: Expressed compensatory signal.



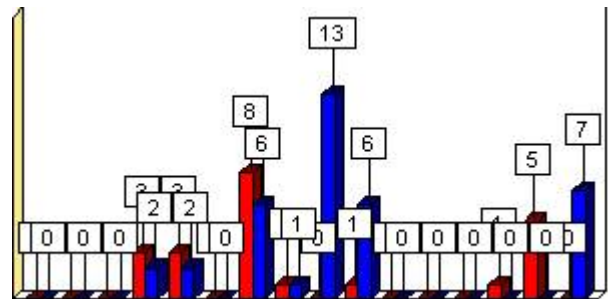
PANCREAS

Age-Related Changes: Weakening of compensatory abilities.
 Sclerotic Pancreatitis: Pathology signal.
 Functional Changes: Expressed compensatory signal.



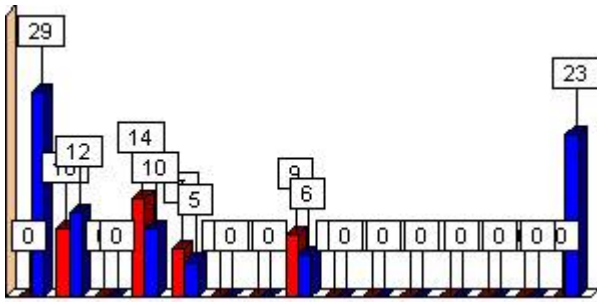
MAMMARY GLAND

Functional Changes: Weakening of compensatory abilities.
 Mastitis: Weakening of compensatory abilities.



HEART

Chronic Fatigue: Weakening of compensatory abilities.
 Impairment of Cardiac Rhythm and Conduction: Pathology signal.
 Abnormalities of Development: Expressed compensatory signal.
 Myocarditis: Compensatory signal.
 Allergic Process: Compensatory signal.



BLOOD AND PERIPHERAL BLOOD VESSELS

Age-Related Changes: Compensatory signal.

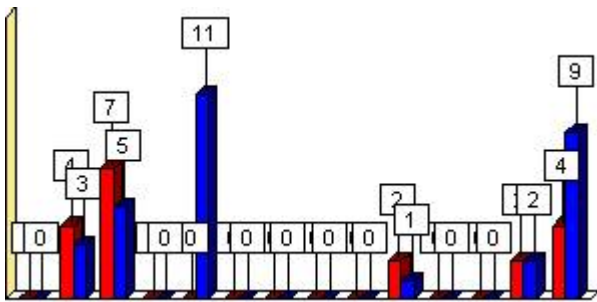
Allergic Process: Weakening of compensatory abilities.

Hemorrhagic Diathesis: Weakening of compensatory abilities.

Neoplasm: Weakening of compensatory abilities.

Anemia: Expressed compensatory signal.

Post-Stress Effects: Expressed compensatory signal.



SPLEEN

Splenomegaly: Weakening of compensatory abilities.

Post-Stress Effects: Expressed compensatory signal.

Tissue Growth: Compensatory signal.

Diagnosable cardiovascular diseases:

Myocarditis, Cardiosclerosis, Ischaemic Heart Disease, Cardiac Insufficiency, Cardiac Myopathy, Angina Pectoris, Cardiac Infarction, Myocardial Dystrophy, Impaired Cardiac Rhythm and Conduction (Cardiac Arrhythmia).

Note: Initial studies by researchers at the Peter Lesgaft Institute, including reports of Virtual Scanning's diagnostic abilities conducted at a number of medical institutes in the Moscow region, have illustrated that Virtual Scanning is able to diagnose medical conditions from the presymptomatic level. This reported on the diagnosis of 370 patients of which 305 were subsequently confirmed by conventional methods of medical diagnosis. The remaining 65 were either false positives or were diagnosed at the pre-symptomatic stage i.e. at a stage of development which was earlier than could be detected by conventional diagnostic test procedures. This indicates that the test may be up to c20% more accurate than conventional scanning procedures.

Summary

This article demonstrates how visual perception is influenced by the function of the autonomic nervous

system and the body's physiology. The cognitive technique described offers the prospect of a complete patient health report in 15-20 minutes. It may be free of the limitations and dangers affecting scanning and biomarker techniques and offers the prospect of dramatically reducing the cost of cardiological testing and of more accurate drug prescribing. The ability to diagnose a medical condition from the presymptomatic level can be used to show how a medical condition develops and how it regresses. It may be invaluable to the GP reducing (1) the time spent testing patients, (2) the need for repeat consultations, (3) referrals to hospital, and (4) may reduce the vulnerability of a GP to legal claims due to misdiagnosis. (5) It offers the possibility of diagnosing medical conditions in cases where specific test procedures are absent or are of dubious validity or where the complex nature of the condition renders it 'of undiagnosable nature' or where a non-invasive test could have significant benefits. It would also reduce exposure to X-rays.

If possible to diagnose progression to disease more precisely and effectively, as claimed by Russian researchers, this may lead to greater precision in clinical trials and hence to more rapid development of new drug entities. The greater amounts of data from the diagnostic test procedure may facilitate (1) monitoring the condition of all organs in the body during a clinical trial, (2) rapid identification of potential drug side-effects, and (3) compilation of a drug's safety profile. It conceivably offers the opportunity to adopt a differential approach in drug trials, using volunteers with differing age groups, which would make it easier to recruit volunteers to participate in clinical trials. It offers the possibility to monitor progression of the disease state from presymptomatic to development and/or its subsequent regression. It may also provide the means to assess how toxic drugs e.g. those used in chemotherapy, could benefit from therapies which can enable the body to deal with the toxic side-effects or where a combination approach involving more than one drug or therapy could be beneficial to the patient.

Competing Interests

Graham Wilfred Ewing & Elena Nikolayevna Ewing (Dr) are Directors of Montague Healthcare, a company dedicated to the future commercialisation of Virtual Scanning. No other organization or person offered any funds to support this study.

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