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Inforamation And Info-Operability Of The Immune System Accoding To The Informational Model Of The Human Body And Eukaryotic Composing Cells

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Abstract:

In this paper it is presented and discussed the info-operability of the human immune system, according to the informational concept defined as matter-related information, operating at microstructural level of cell and body, based on the interactions between the micro-material components under a permanent dynamic process, as complex compounds or decomposing systems in constitutive components, with absorption and release of information. It is possible thus to describe coherently the metabolic and genetic processes, for the body maintenance and its growth/development or the plasticity of parts of it, and the info-relation with the brain, the central managing operator/processor of the entire organism. The identification of the specific distinct components of the informational system of the human body and of the eukaryotic composing cells themselves allows to describe the communication between the brain and body, performed mainly by YES/NO binary Bit-type mechanisms, both at the macro and microscopic levels of the constitutive cells, and to approach within the frame of the defined informational model of human and of the composing eukaryotic cells, the info-operability of the immune system, composed both by mobile cells and fixed macro-components of the body, a critical issue in Immunology not yet understood up to date. It is emphasized the high informational operability of the components of the immune system, according to the informational model of the human body and the composing cellular components, experimentally proved, and its great capability/versatility of expression, highly supporting the informational model.

Keywords: information/info-operability, matter-related information, informational model of the human body and of the eukaryotic cells, info-genetic generator, immune system, immune B-cells/T-cells, surface receptors, info-communication/genetically-assisted informational processes.

Introduction

Information is a universal presence everywhere in nature [1], in the social current communication and activities in industry, education, medicine, management [2-4] and in mass-media communications {5], but about the fundamental factor in the structuration, functions and in particular the important key role in the behavior activity/operability of the immune system is insufficiently considered [6]. Deeper and remarkable advances were however reported on the new opened way of investigation, which recognizes and places the central role to information in the living structures, in particular in human [7,8], which not only animate them in connection with their needs to find the necessary material resources in their environment and to defend against macro and micro dangerous attackers/invaders, be they toxic substances foreign to those of the body, or living organisms – viruses and bacteria, but also to structure/restructure their organism, and assisting it for adaptation [9-12]. Such

advances not only drain and effectively drive the ancient humanity essential problems to a solution, like the relationship between the body and the mind [13,14], the matter/info bipolarity of the human body and living structures [15-16] in philosophy, psychology [17-20], neurosciences/neurology [21-24], geriatrics and gerontology [25-27], up to therapeutic rehabilitation treatments [28], information and info-modeling in plants [29,30] and animals [31], in biomedical engineering [32,33], biotechnology [34-36] and biometrics on COVID 19 control [37,38].

In this paper it is discussed the info-operability of the immune system according to the informational model of the human body (IMHB) recently developed [10], and revealing the similar informational structure of the eukaryotic cell, as a basic elementary component of the human body and animals, showing that this activity can be understood by using informational concepts concerning the matter-related information and communication between the micro-material components of the body and between them and macro-components – organs, tissues and the brain, the central info-manager of the body.

1. Information and Informational Model of the Human Body (ISHB) and of the Composing Eukaryotic Cells

Information from the perspective of the science and technology of information, firstly developed for electronics communication systems [39], is related to the communication between an information source and a coder of information, a receiver and a decoder of information linked by a communication channel, treated in YES/NO-like, binary – Bit terms. The accuracy of the transmission and reception, a common issue in all the communication systems, depends on the encoding of information at source, on the errors induced on the transmission channel, and on the decoding abilities at the receiving terminal. How should be understood such a communication in the human body in terms of information, it is explained in continuation. In the living organisms, in particular in the immune system of human, two main forms of communication should be distinguished:

1. The transmission/reception of signals between interacting components of the body by structuration/destructuration mechanisms, transmitting the information through the various channels to the body structures/components. In the immune system, such a communication takes place especially between the immune cells themselves and between they and the immobile components (thymus, spleen, nodes) and the brain, assuring the coherence and correlation of the response and action, according to the local necessities, on the tridimensional (3D) map of the organism.
2. The interpretation (decoding) of the received signals in the brain, in particular referring to the meaning/significance attributed to the received information from the surrounding reality at the mind level, decoded by language [19,40,5].

The first type of communication is based on the matter-related information, which result from the decomposition (or copied exemplar)/re-composition or destructuration/restructuration of the compounds during the molecular/micro-component processes. One of the most suggestive matter-related informational process is the transmission of information during the transcription-translation in cell by sequential processes of the gigantic deoxyribonucleic acid (DNA) molecules from genes to proteins [12] – the building bricks of the body, via ribonucleic acid (RNA) intervention, as it is schematically shown in the right-bottom side of Fig. 1, representing the body eukaryotic cell, its organelles and working processes, and expressed by the relation:

DNA=>mRNA (RNA messenger)=>tRNA (transport RNA in the ribosomes)+(aminoacids)=>Protein (1)

This is only a particular case, consisting in the info-transmission by various combinations of DNA sequences in the “language" of four “letter" alphabet of the nucleotides, i.e. adenine (A), guanine (G), thymine (T), and cytosine (C) in DNA, adenine, guanine, uracil (U), and cytosine in RNA, combined with the contribution of amino acids from the 20 type existing possibilities, to form a certain protein, with adequate characteristics according to the body necessities of structuration or functionalities [14]. A basic rule of coupling by means of a hydrogen atom between these constitutive elements is that they are complementary structures, admitting only a binary YES/NO-type combination A-T and G-C in DNA and corresponding A-U/G-C in RNA. The genes of genome contain therefore the entire necessary (binary) information for body structuration and traits/behavioral expression. More general, the interaction between two micro-

components, like for instance between a ligand (external info-chemical agent) and a specific surface receptor of a cell membrane, triggering a chain of specific reactions in the cell cytoplasm, is also a matter-related information process generated by structuration/destructuration mechanisms. Such a process of interaction between two components A and B, with absorption and releasing of information denoted by the symbol I, could be schematically/ formally written as:

$$(A+B) + I <=> (AB(I)) \quad (2)$$

where (I) is the absorbed information in the composed system (AB) during the forward-type (=>) reaction, which can be released during the destructuration processes, represented by a revers-type (<=) reaction. In the nervous system, the excitatory/inhibitory neurotransmitters accessing the synapse, could trigger or not the fairing mechanism of the nervous cell, as a YES/NO – Bit-type operation. Each message is distinguished from others by the number and frequency of the electric pulses and the nature of neurotransmitters, which moreover intervene in such a communication process between two neighbor neural cell, by a inhibitory/excitatory YES/NO – Bit-type competition.

With these specifications, it can be distinguished the following informational systems in the human organism (Fig.1 central side) and eukaryotic cell (bottom-right side) [11], which show similar informational structure and functions: (i) CASI (the center of acquisition and storing of information – memory), which is defined as the info-activity supported by the sum of all brain areas in human and memory-related network in cell, (including the surface receptors), connected with the network of sensors for the detection of the external/internal signals and with the prefrontal cortex for short-term memory, with hippocampus for long-term memory in human body, and with cerebellum for acquired motor-type abilities; (ii) CDC (the center of decision and command – decision), connected mainly to prefrontal cortex and the hemisphere cortex areas for judgment, analysis and decision, and with the voluntary execution elements (EE) – muscles, in particular with the vocal system, as an expression of the info-output attitude, and represented in the elementary cell by the network of the decisional chain cascade reactions for a reactive response to info-input; (iii) IES (the Info-Emotional System – emotions), connected in human with the limbic system (hippocampus, amygdala, hypothalamus) and with hearth – the emo-sensitive feeder with nutrients for the tissues in momentary need, all of them connecting the organism to the external/internal reality for adaptation, in the eukaryotic cell defined as an info-reactive sentience system (IRSS), which represents the own sensorial “feeling" of the received information as an effect induced by the info-input signal.

The automatic informational components of the organism and the composing eukaryotic cell can be defined as following: (iv) MIS (the maintenance informational system related to the metabolic processes), connected with the brain stem and expressed especially by the digestion; (v) GTS (the genetic transmission system – expressed by sexual activity as a genetic info-output in human organism), managed by hypophysis and hypothalamus, and by reproduction/division of the cell through the replication process (Fig.1); (vi) IGG (the Info-Genetic Generator), expressing/coordinating the genetic inheritance – the genetic info-input of the body, with development function depending on age and on the body circumstances, managed basically by hypophysis and hypothalamus too, and in the cell by the transcription/translation process for the fabrication of the necessary proteins for the body structuration. IGG includes also the immune system, composed by the lymph vessels and nodes (where the fighting B and T cells against the pathogens can travel in any part of the body), thymus, spleen (where the cells are “educated/trained" to specifically/differentially act), some small defense accessories at the main body entrances (adenoids, tonsils, appendix), and the hypophysis/hypothalamus axis in the brain, where hypophysis is the gland master of the organism and manager of all other gland components (Fig.1 left side).

The Info-Connection (IC) center was defined as a YES/NO decoder/distributor of information to the prefrontal cortex (CASI/CDC) and to the corresponding processing region of the cell, advertising on the deviation from the right/reliable learned/inherited behavior of acceptance/rejection mode/orientation between certainty vs. uncertainty [8], in interaction with the society or unknown situations/events or for the fulfillment of the required/

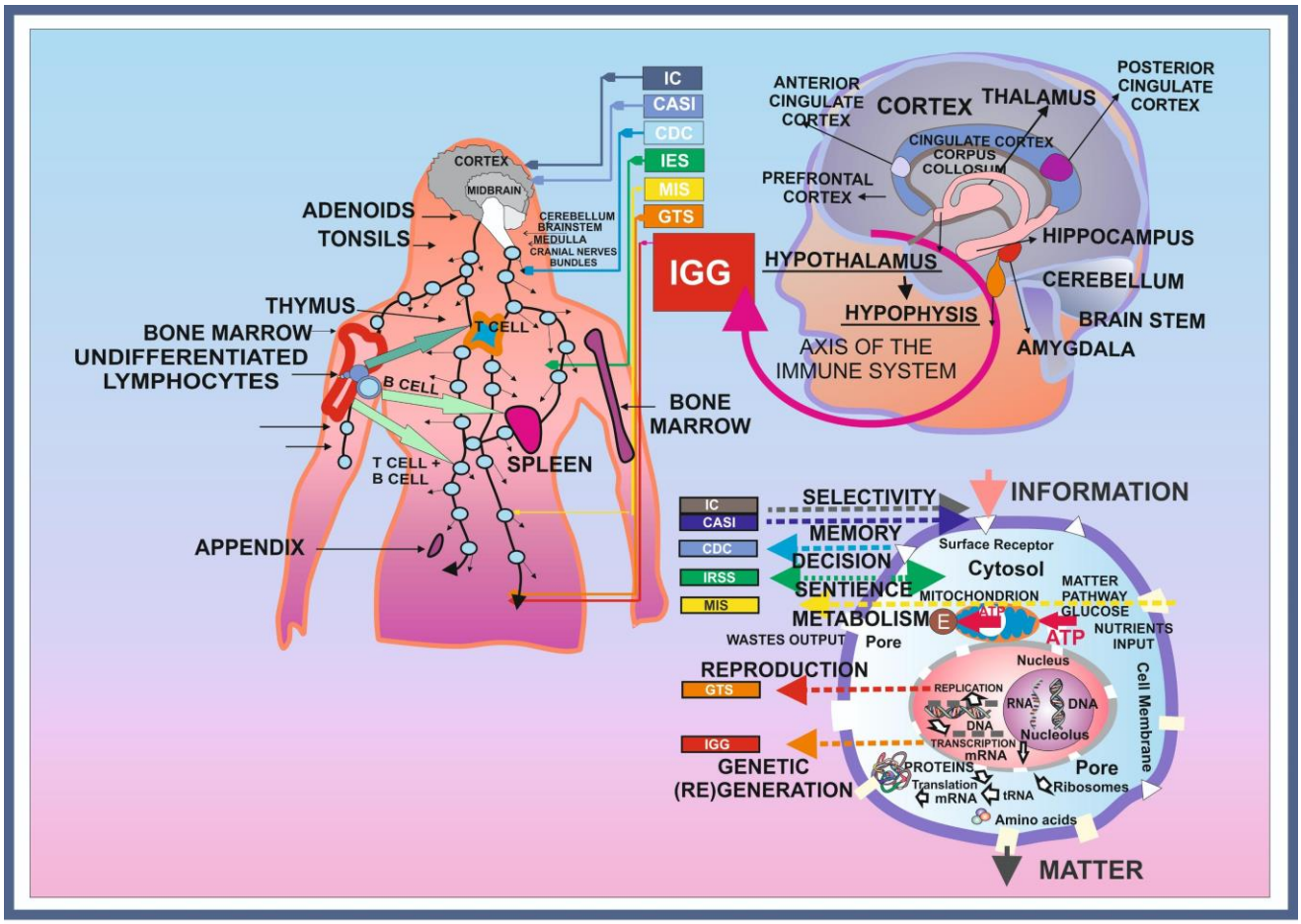

Fig. 1. Schematic presentation of the Informational System of the Human Body (central side) and Eukayotic composing cell (right-bottom side), the relation with the body (left side) and with the central coordination in the brain (right upper side). A schematic representation of the Immune System is shown in the left side of the figure.

duty tasks of the cell as part of the tissues or specific organs of the body, in particular that of the singular cellular fighters in the immune system. This is supported in the brain by the anterior cingulate cortex [21,42] (Fig.1 upper central side) and by the corresponding network in cell (right bottom side of Fig.1). The definition of IC is based on experimental results with the electro-encephalographic method in huma [42], indicating that a 'distress signal' upon the detection of errors/conflict and expectancy violation, called the error-related negativity (ERN) is produced for a disagreement between the input information and existing accumulated/inherited data or expectation [41]. The posterior cingulate cortex is also a part of IC, because this works as a YES/NO switcher between the external and internal (virtual) reality, driving the daydreaming disruption and planning of future new projects, solutions and goals, as a "premonitory"/scrutinizer of the coming events [43].

The info-activity of the Informational System of the Human Body (ISHB) is expressed therefore as a combination between the Info-Activity of all informational components described abase, as following:

IMHB = (CASI + CDC + IES) + (MIS + GTS + IGG) + IC = OIS + PIS + IC (3)

where OIS=CASI+CDC+IES is defined as the operative informational system for adaptation and PIS=MIS+GTS+IGG is the automatic programmed informational system. With an automatic operability like PIS, IC manages/selects the information in a YES/NO manner to the prefrontal cortex, during the OIS connection to reality, serving therefore to a right error-free decision/orientation in the life for human, and in a reliable work for the cell. Similarly, the informational system of a eukaryotic cell can be also expressed by the same type of relation, with IRSS

instead of IES, explaining the compatibility in functions between every cell, even differentiated, and with the corresponding components of the body.

2. The info-operability of the immune system according to IMHB and cell informational model

The activity of IGG where the immune system is involved, working to defend the body against the foreigner micro-organisms and any other kind of intruders, starts from the first moments of the evolution of the new living being, by body growth and cell differentiation in organs, and drives and develops this task according to the age. The immune cells, still undifferentiated in specific features, are generated in the bone marrow, and follow the spreading ways by lymph vessels for action if the case, everywhere in the organism, so the communication between them and with the IGG zone in the brain is really necessary [44], allowing that the fighting cells to be “aware"/informed on their actuating/effector tasks and duties [45], at the suitable moments and place.

Among the communication processes between cells and various organs, all of them types of communications being involved in the activity of the immune system, i.e. the endocrine for a long-distance range communication by hormones, the paracrine communication for short-distance range by a diffusion process, like the neurotransmitters in the nervous synapses, the direct-contact communication by informational transit through gap junctions, which are intercellular micro-channels or bridges between the neighbor cell membranes, the autocrine communication is distinctly from all above, consisting in the communication of a cell with the cell itself, acting as a forward-feedback loop circuit, able to self-sustain the growth of the cancer cells or inflammations by intervention of the grow factor, and the macrophage mechanisms of white molecules in the immune system [46]. However, under normal conditions, the involved fundamental driving role is played by the nervous system – specifically by hypothalamus – and by endocrine system, leaded by the hypothalamus-hypophysis tandem [46]. Concretely, the long-range hormones modulate/play a regular function of the immune system in response to activity arising within hypothalamus. This is done by a (iii)-type communication, operative especially at the nervous/hypophysis interface, where the neurons activity activates the secretion of hormones in the hypophysis gland, which drives the activities of all other glandes of the endocrine system [46]. Hypothalamus and thalamus are also interconnecting brain regions with the basic functions of the organism [46] between inferior (brainstem supporting the MIS and sensorial input of CASI) and superior linked echelon (IES limbic system, CASI/IES/CDC), fulfilling fundamental role in the metabolic support and in aware states of the mind. The hypophysis is at the interface with the brain the main communication headquarter for hormonal long-range info-transmission, stimulating the bone growth and stem cells inside (IGG), the production and secretion of breast milk and uterine contractions (female GTS), the production of ova and sperm by the gonads (male and female GTS), of the production of components with analgesic (anti-pain) properties [47], and of some regulation processes of metabolism (MIS).

As the immune system is effectivelly cognitive, decisional and executional, as it is demonstrated also below, this shows actually the main specific features proper of an informational system, because is able to discover/“know" differentially the dangerous products and micro-organisms (pathogens) everywhere in the body, and to “decide" and transmit the decision to the execution effectors (fighting individual cells) to act for their inhibition and elimination. In Fig.1 are shown the main components of the immune system [46,47], which are: the hypothalamus/hypophysis as a headquarter of coordination, the lymph network consisting in nodes and lymphatic vessels for the circulation of the cells called lymphocytes – a species of leukocytes, which are the blood white cells and for the leukocytes themselves – generically called white cells (spread in the blood and lymphatic system, and acting as active agents of surveillance and alarm against pathogens and body infections), the thymus (where are produced and “trained" T-cells), the spleen (where the specialized innate B immune cells generated in bones), natural killer (NK) cells (which do not require activation in order to kill cells, rejecting tumors and cells infected by viruses through a programmed death process), and macrophages gather and work, the bone marrow (producing and stocking white and red cells), and the associated immune accessories (tonsils, adenoids and appendix) located at the entrance gates of the organism. The B and T cells act in the adaptive immunity as follows: the B cells assure the antibody mediated

immunity, producing antibodies (white-like blood cells) used to attack invading antigens, while T cells work as the cell-mediated immunity, destroying the body's cells invaded by viruses or cancer, the T, B and NK cells representing practically the content of the lymph nodes and about 20-40% of body's leukocytes [48,49].

Normally, the immune cell are differentiated by functions, but under dormancy/standby/inactive state, till the discovery of pathogens/antigens, when they are activated. The activation (communication) is performed by means of molecules, circulating by the fluid circuits of the body. The immune cells configuration/reconfiguration is typically performed by structuration/restructuration processes with absorption/release of information, as expressed by rel. (2), through DNA sequential language, during the transcription/translation mechanisms of various species of proteins, differentiated in specific functions for building of the body cells and plastic modeling (IGG), for communication as informational agents, or for the formation/configuration of the surface receptors, which select the informational signal according to the programmed cell tasks (IC/CASI). These modulation processes are based actually by the genetic-assisted mechanisms for the genes expression of the behaviors and traits, either inherited or acquired ones, by epigenetic processes. The immune cells are able to discriminate between body cells and intruders by interaction/decisional processes (CDC), and reconfigure their body accordingly (IGG), to eliminate them by phagocytic (ingestion) intervention. The behavior of the immune cells constitutes the more evident and representative example of adaptive rapid plastic/functional reconfiguration (IGG) as a response (CDC) of interaction with the environmental neighborhood, subject to necessities to the whole body, working in syntonic mode and on the same principles [12].

Indeed, as it is shown in Fig.1 right-bellow side, the metabolic processes in eukaryotic composing cells are managed by MIS like that of the human organism, which runs the specific chemical reactions on specific pathways in the cytoplasm body, engaging similar organelles: vacuoles like a stomach, the mitochondria like a lung, producing energy from adenosine triphosphate (ATP) in interaction with oxygen, the Golgi apparatus as a “heart”-like/blood vessels distributer of fluids, the endoplasmic reticulum and lysosomes like a pancreas and spleen with role of lipid (fats) and insulin management for degradation of obsolete products. The activity of GTS is played by multiplication/replication mechanism, and of IGG by transcription-translation, CASI is represented by the network of sensitive/sensorial surface receptors and the nucleus, the informational master memory of the cell, CDC by decisional network of the reactive pathways in the cytoplasm, IES by the info-reactive sentient system (IRSS), and IC by selective network of the specific signals according to the specific/special tasks and functions of the cell, assuring the right designated functionality. This system maintains the right significance/interpretation of information which enter into the decisional chain response circuits, to avoid a wrong CDC decision making. A dysfunction of IC in immune cells, equivalent with a bad interpretation of signal, leads to dysfunctions of the body cells, manifested by allergic symptoms or diabetes, and disorders like cancer, asthma and arthritis [46], or even disorders of the central nervous system [50]. On the other hand, it is also evident that the reactivity of the immune system is a sentience/reactive response also for the involved cells themselves (by IRSS) at local level, and also at the macro/central level (IES) of the organism, by the effects of inflammations or by other associated symptoms.

The innate (nonspecific, pre-programmed) immune system, learned already during the evolution of species and incorporated into the genetic info-structure of the cell, consists mainly in the physical barriers (skin, mucous membranes in lungs, intestine), antimicrobial secretions (stomach, mouth), cilia [51], macrophages and cytokines cells, small molecules which activate the immune system [48,52], serving therefore as triggering communication informational agents. The adaptive immune system acts individually by learning/training/acquirement of suitable “education" (new traits and composition/structuration by IGG) of lymphocytes (white blood cells) during a first interaction with specific pathogens of an infection or vaccination. The usual process of learning is an informational process assisted by epigenetic processes, in which an information intensively or repetitively received by cell is integrated in the genetic system [53] (rels. (2)), remaining in the cell memory both for antibodies fabrication or specific adaptive immune actuation after a first step of “training" (like

vaccination) [54]. However, the innate response could be initiated actually by a rapid sensitive/reactive process for the triggering of specific generic mechanisms for adaptation, activating adequately the dormancy genes. The innate responses call (initiate/activate) the adaptive immune responses into play, to work together for the elimination of the pathogens [55]. The ability to distinguish the foreign pathogens from self cells or molecules (represented in terms of the Informational model by CASI-IC/IRSS/CDC => IGG => (antibodies fabrication) => executive effectors – antibodies) is a fundamental feature of the adaptive immune system. If this fails to make this distinction (according to IC "tuning"), this starts to react destructively against the host's own, inducing autoimmune diseases, disastrous/fatal consequences are produced.

Within the info-communication process of the immune system, the antibody responses (triggered by any substance capable of eliciting an adaptive immune reaction, referred to as an antigen – antibody generator), the B cells are activated (CASI-IC/IRSS/CDC=>IGG) to secrete antibodies – proteins called immunoglobulins, which circulate in the bloodstream and other fluids as info-agent, to bind specifically the foreign antigen that stimulated their production, inactivating (effectors) viruses and microbial toxins. Moreover, they also marks (bind) invading pathogens for destruction, mainly to make them easier for phagocytic cells of the innate immune system to ingest them (IGG => plasticity process => ingestion), by the schematic relation CASI-IC/IRSS/CDC => IGG => (cell plasticity) => executive effector (ingestion). The first step of the initiation of the immune response is the activation (info-signal=>CASI-IC/IRSS/CDC) of monocytes, macrophages, dendritic cells, and neutrophils, all of them belonging to the innate system, which produce cytokines, an info-chemical agent triggering the hypersensitivity response (CASI-IC/CDC) of the action cells (effectors), manifested by tissue inflammation (IRSS/IGG), edema, or smooth muscle contraction (EE). The predominant leukocytes of the native immune system (about 70% of white cells), are the very motile vells called neutrophils, which intervene the first in the tissues of inflammations attacked by the bacteria infection or of some forms of cancer, engulfing (IGG producing plasticity => effector) bacteria or microparticles [56]. The mechanism of detection (CASI) and movement (CDC=>EE) to the infected site (chemotaxis), is related to the ability of their surface membrane receptors (sensors of CASI) to detect chemical gradients of specific molecules (like a "smell" sense), determining cell (CASI-IC=>CDC=>EE) to direct and follow a suitable path toward the target. Macrophages are immune cells highly specialized in the removal (CASI-IC=>CDC=>IGG => (plasticity of the body => ingestion) of dying or dead cells and cellular debris. The macrophages are generated by differentiation of monocytes (involving IGG), one of the major groups of white blood cells of the immune system, which enter the infected or damaged tissue or organ [56], where develop and mature (IGG). Moreover, the cardiac resident macrophages participate in electrical conduction via gap junction communication with cardiac myocytes [57], serving therefore as info-conduction agents.

Macrophages show a broad range of communicating and recognition abilities with the altered self components of the host and of the microorganisms, by means of their surface membrane receptors (CASI-IC) followed by surface changes (IGG info-assisted adaptation), uptake, signaling, and altered gene expression (IGG), contributing to homeostasis, host defense, innate effector mechanisms, and the induction (=activation=CASI-IC/IRSS/CDC) of acquired (info-adapted) immunity [58], highlighting the defining importance of the surface receptor (CASI-IC) implication in the specific inter-cells info-communication mechanisms (IRSS/CDC) and further consequences (CDC=>IGG). Dendritic cells can be found especially in skin, nose, lungs, stomach and intestine, and migrate (CDC=>EE) to the lymph nodes to interact with T and B cell for activation (CASI-IC=>IRSS/CDC) of the adaptive (=>IGG) immune system.

Dendritic cells are an example of continuous info-communication with other cells, especially by cell-cell contact with lymphocytes or at distance via cytokines [59,56]. Within such a communication process, the cell responsivity (CDC) depends first of all on the selective specific availability (IC), info-affinity (IC) and functionality of the surface receptors network (CASI), which is a key for the further interpretation (IC decoding) of the external signal at this informational input.

Besides the ability to memorize and produce the necessary reaction against a specific antigen invading the organism by B memory and T memory cells (CASI adaptation by IGG), a remarkable/key property of the immune system is its capability to distinguish/identify (CSI-IC/CDC) the foreigners and the infected cells from the host cells by a self/non-self discrimination process. This is complied by two ways: by the T cell-mediated-immunity, which does not involve antibody intervention, and by the implication of the B cell activity by means of B-cell humoral immunity mechanism, with the involvement of antibodies, as presented above. The T-cell self/non-self recognition mechanism is based also on the differential capability of the surface receptors (CASI) to distinguish selectively (CASI-IC) the various other cells or even peptide fragments of antigens (by intervention of cell surface glycoproteins as info-agents) after the process of phagocytosis (IGG -assisting ingestion) [60]. These mechanisms show again that the central operability of the immune system is driven by informational processes, as a combination between genetic-assisted info-generation (IGG) and communication mechanisms (OIS), assuring the local reconfiguration of the body structure (IGG-assisting plasticity) and functionality by structuration/destructuration mechanisms, according to the necessities (effectors), as described by rels. (2), within the frame of the informational model.

T cells are also differentiated by functions, the most important from the operational point of view being the helper T cell (for B cell (IGG involving) maturation/education in thymus – for full functionalith), and effector T cells, executing the immune operation (CASI-IC/IRSS/CDC=>IGG =>effector). Each of these types of cells performs distinct functions, although each is composed structurally by similar organelles and info-structure, being a relevant example of how each of them organizes itself the own informational activity and structural tools for a suitable responsive/decisional behavior. B cell memory is another example of specialization, referring to the memory of functionality/response/decision of the cell as typical one, after a first exposition to a pathogen in an natural or vaccination way [54].

The acquired (specific) immune system works mainly with macrophages, B and T cells. The key process of recognition is supported by complex activator/ inhibitory (YES/NO) surface receptors [61], operating therefore like YES/NO Bit-type informational micro-devices. The internal response is highly determined furthermore by the tissue context and cellular interactions that influence effector lineage fate decisions (CDC), engaging the cytoplasmic signal transduction, nuclear transcription factors, and mechanisms controlling gene expression (IGG). Specifically, the initiation and the transmission of information in leukocytes, which is one of the most complex transmission/decisional process, follows the main steps and associated mechanisms [61]: (i) the initiation of the info-communication process by the binding of a specific ligand (signal), which can be cytokines or other molecules present in other cells, toward the corresponding surface receptor, consisting in general in one or more transmembrane proteins (always the tandem should be compatible, complementary each other); (ii) the transmembrane cytoplasm reactive pathways, anchor the receptor chains in the plasma membrane, initiating the reactive transduction of the initial signal into a bulk intracellular information, typically by a cascade of reactions of phosphorylation or dephosphorylation (so in a YES/NO fashion, according to informational model), with an end parkway in the cytoplasm itself, by the intervention of mediators such as calcium ions from their sequestration in some special intracellular storage structures; (iii) however, as an effector/executing action is required, the intervention of specific proteins which should carry out this action (like antibody immunoglobulin gama), fabricated by a transcription process described above is necessary, and executed by the stimulation of the dormant/silent genes (IGG), so with the contribution of the genetic mechanisms. Such mechanisms illustrate specifically the transfer of information as described actually schematically by the relations (2), according to the informational model. The close info-communication between the T cells (helper variant) and B cells, stimulate B cells to fabricate antibodies (specifically immunoglobulin) and help natural killer T cells (NTK) to destroy the target – the infected cells [62]. The memory T cells, acting within the specific immune system, are generated from the effector T cells in thymus through epigenetic modifications, so by means of an info-communication mechanism [63-65], similar with that described above. Because the B memory cells can be formed only by communication with T helper cells, these cells appears

later, acquiring migration properties toward spleen and nodes [66].

All these processes described above in terms of information and informational system of human body and eukaryotic composing cell, stromgly support experimentally the informarional model itself, showing that the runing of the involved “machinery" is elegantly and precisely describable by means of the informational components of these systems and their operational capabilities.

Conclusions

It was shown that the concept of information in the human body and the composing eukaryotic cell play an indispensable role for the structuration and functionality of the cell as elementary basic component of the human body and of human as multicellular organism. On this basis, it was shown that the immune system reveals a remarkable panorama of a large variety of the immune cell behaviors and close inter-communication with the brain for the fulfillment of their tasks, outlining/demonstrating the essential implication of information in their activity, expressed by seven main operability systems, like the human body itself. Every action of the eukaryotic immune cell, from info-communication with the other components of the organism supported by the operative information system, to the info-structuration and (re)configuration of their own body in an adequate way to fight against the body invading pathogens and foreigner microparticle toxic products, based mainly on the activity of the info-genetic generator and genes activation, is related by the dynamic inter-playing communication between the cells with the brain and between the informational components of the informational system of the cells and of the human, highly supporting the informational model of the human body and of the composing cells themselves.

Besides the high contribution for the understanding of the immune mechanisms and functionality both of the human structures and of the composing cells themselves, a great merit of the informational models consists in the capability/versatility to permit a clear and synthetic representation of the complex activities driven/based on information, although each of the informational component is supported by a sophisticated operational “machinery” based on chemical reactions, allowing to express them by suggestive info-operational schemes, which offer a valuable and clear picture of the info-relarional mechanisms and their consequences.

The informational models demonstrate that the activity of the immune system is informational, subscribed to the info-genetic generator (IGG), operating by the contribution of the genetically-assisted processes initiated via the OIS-driven communication by informational matter-related agents with the constitutive immune themselves and with the central driving info-manager in the brain, and of the distributed components of the body. A key role in the immune processes and info-communication is played by the surface cell receptors as CASI-like attributed sensor/local memory and as info-connection-assigned system for right/reliable communication with the other components of the body and with the cell body itself, which can be configured/reconfigured by the activation of the dormant genes (IGG), through the CDC-assisted chain cascade of reaction response induced by an external signal received at the surface receptor (CASI-IC), acting basically as an YES/NO Bit-type informational micro-device.

The right functioning according to the local tasks and goals of a cell is assured by IC, through selective action of the surface receptors and internal micro-reactions on the suitable reactive pathways, avoiding anomalies of operability which can generate dysfunctionalities like allergies and diabetes, or disorders like cancer, asthma, arthritis and even disorders of the nervous central system. In particular, it was demonstrated that the operations of the local immune system engage also info-sentient consequences involving IRSS/IES at the local and central informational systems, by inflammations and or by associated symptoms, well supporting the informational models. It was shown moreover that the immune cells could act as info-communicative and/or executing effectors (killers and phagocytes cells), in a complex/complet info-dynamic and multi-spatial activity on the 3D map of the organism, coherently managed by the central informational system.

The behavior of the immune system in the human organism demonstrates in a spectacular way the validity and the high capability of the informational model of the human body and of the eukaryotic composing cell to express the real complex

biological/informational processes in a suggestive and clear way, revealing also the high/effective and indispensable informational operability of both of them.

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In the memory of my loved parents, Emeritus Professors Emanoil and Florica Gaiseanu, of my brother Professor Constantin Gaiseanu and of all my family members.

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