Letter to Editor

Evolutionary Paradox of Immunity

Dear Editor,

Immunity is the sophisticated ability of all multicellular organisms to maintain integrity of its composition and a homeostatic balance of their internal milieu. Immunity determines the genetic stability of each individual, and subsequently the long-lasting evolutionary stability of the species. In reality, immunity keeps all changes induced by internal mutations or by activities and products of enteropathogensat minimum, as the actions possess a capacity to threaten the integrity of an organism.

There are two fundamental types of evolution of life on the Earth. At the emergence of first signs of the life, perhaps 3,800 million years ago, the living forms comprised only prokaryotic, microscopic and asexual organisms. In this RNA/DNA world, the evolutionary innovations were originated by gene changes at the nucleotide level (non-lethal mutations, gene duplications, inversion or other genetic manipulations) and also by mutual gene lateral (horizontal) exchange. This Precambrian biota living 85% of Earth Life time was characterized by hypobradytelic evolution (stasis). Emergence of primitive unicellular (colonial) eukaryotes, more than 1,000 million years ago later, was caused by genetic information transfer across species boundaries. This lateral gene transfer resulted in the burst of multicellularity in Edicarian and particularly in Cambrian, some 600 million years ago. This megascopic, aerobic and sexual Phanerozoic biota occupies only 15% of Earth Life time. It is characterized by horotelic evolution with distinguishing extinctions/radiations periods.[1] From evolutionary view, the mobile DNA/RNA elements (transpozons) of viral, prokaryotic or eukaryotic origin are capable overcoming the host immune barriers. It is important to remember that these barriers could represent potential vectors or direct donors of genes bearing new genetic information needed for evolutionary innovations.

So why defend against alien, why immunity is needed? It is clear that multicellular organisms have never evolved alone in a splendid isolation from other living beings.[2] Not evolution, but co-evolution formatted life since its dawn on the Earth. Co-evolution has been accomplished by means of horizontal information transition, which seems to be a major evolutionary force. Consequently, living organisms as thermodynamically open systems inevitably must exchange, accept, and transform information. Their existence, cooperation/competition, and adaptive radiation are simultaneously dependent on the defense of their internal integrity. All Phanerozoic eukaryotes are endowed by various forms of defense of "self," which in fact are constricted by their basic body patterns.[3] On the other hand, genomes are not protected by any immune system. Why did sophisticated immune systems evolve to protect the integrity of an individual, when the genomes are open for entering and accepting "non-self" genes, and what is the evolutionary justification of defense of "self?" We must be aware that actual genomes of all living beings are synologs, the agglomerates of autochthonous genomes with xenologic, alien genetic contributions from others. Organisms that express properties and products from foreign genes are numerous. Even in humans, according International Human Genome Sequencing Consortium, mobile genetic elements form as well as a half of his genome.[4]

What happened before the emergence of gnathostomian vertebrates? The groups of virulence genes could transfer new biological information into the genome of placoderms. It could be a benign infectious process that initated the formation of a new defense strategy. It is possible that adaptive immunity developed as a result of some infectious process. What, for decades, appeared as a result of immunological Big Bang most probably developed throughout tens of million of years by slow, step-by-step adoption of the genes necessary for out of genome diversity. V(D)J recombination of the imunoglobulin family became the most successful system of adaptive immunity.[5] It may be hypothesized that the primordial lymphoid cell lineage of these predecessors of gnathostomes was sufficiently plastic for acceptation of recombination-activating genes (RAG) cassettes, which allowed the use of molecules of immunoglobulin super family as defense weapons (antibodies, *etc.*). The majority of agnathostomes with their adaptive immunity being based on LRR (leucine-rich repeat) proteins disappeared more than 400 million years ago and the two current orders consist of, compared to immunologically more successful vertebrates, only handful of species.[6] Thus the onset of adaptive immune strategy is tightly connected with lateral gene transfer. However, we still know little about the natural pressures leading to the creation of the vertebrate type of immunity, nor about the time at which the first sign of this immunity emerged. It is probable that adaptive immunity evolved against the background of the invertebrate defense reactions which were tending toward some degree of specificity on the phylogenetical level of the first chordate vertebrate ancestors.[3]

So the question is: Do we need immunity? It might be possible to conclude that immune systems occurred more by pure luck and that their existence has only

limited impact on animal kingdom. We are, however, convinced that without the slow development, and in its reality extremely complex array of immune reaction, the Earth would still be covered by primordial soup full of prokaryotic animals. We have to remember that regardless of any horizontal exchange of biological information which might play a role in the evolution of immunity, there is no function without structure, and there is no structure without a history.[7] The immune strategy represents an appropriate morpho-functional pattern determined by a common body plan which itself has emerged during the evolutionary process, mostly under the pressure of the natural forces of environment.

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