



The Deep Scientific and Philosophic Approach to the Future Nanomedicine, Given on the Base of Author Introduction in the Monograph “Nanomedicine, the Greatest Challenge of the 21st Century”

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Introduction

The book “Nanomedicine, the greatest challenge of the 21st century” was created in a completely unusual way. It was developed as a puzzle in which many concepts, seeking their explanation within the long maturing conception, began to connect in a very unusual ways thus making a tissue of completely new entirety woven as a mosaic in which the most essential questions of human life are opened and surprisingly imaginative responses are found. By connecting information and knowledge in various fields of technology and science, directed to the deciphering the most important questions of life related to human health, the length of his life, death and reaching the eternity; curiosity, from which this book sprouted, received new and new stimuli, and together with these stimuli it was growing and obtaining its visage. The movement from one area to another, guided only by intuition and coincidence on occasion, led to confusion and to inspiring new incentives, so in a way it's resembled a lonely journey through infinity where at any time the selection of path was entirely dependent on the new curiosity about the landscape which until then I had no idea even existed. Meanwhile, the various horizons were opening and, together with them, numerous possible and impossible topics and mysteries of human existence and life. I was more and more aware that the boundary between myth and reality, truth and illusion is so infinitely thin that it is usually not distinguishable.

Therefore, I will start this preface with the biblical story of Adam and Eve, the one that is a single and unique because it is made from Adam's rib, as it is written in the book of Genesis. This is probably the first recorded example of tissue engineering, making Adam the first donor of the human species. There are also unique examples of tissue engineering in Greek mythology. One of these is the legend of Prometheus, who stole fire from Zeus and gave it to humankind, wherefore Zeus chained him to a rock where the vultures were tearing his liver every day. That liver, according to the legend, renewed each day anew, and so from day to day. Today, for researchers in the field of molecular biology and medicine this legend represents a metaphor of restoring the human organs through the use of human stem cells, due to their unique ability to renew and differentiate into various specific cell types. Stem cells have become a tool for the regeneration of various tissues and organs, because they can be transformed into a required cell types with characteristics that are harmonious with cells from which these organs are composed.

In the epic of Gilgamesh, magnificent literary work, which dates from the 22 century BC, the hero Gilgamesh, which is one-third man and two-thirds god, dreams of immortality. In these beautiful meditations and images remains puzzling which is a possible form of an infinite life and what the immortality of the soul might be.

In many works of artists such as the famous painting “Healing of Justinian” by Fra Angelico shows the legend of Saint Cosmas and Damian, depicting the miraculous transplantation of the black feet of an Ethiopian to a white patient, which is one of the earliest legends so closely associated with regenerative medicine. In literature and art, there are numerous examples in which the idea of creating living individuals or parts of individuals is expressed, in which a man himself is a creator, taking over the role of the Creator. During the period of transition between the Middle Ages and the Renaissance in Europe, many scientists believed that alchemy of living organisms can be realized. So Theophrastus von Hohenheim, better known as Paracelsus, tried to find a way to create human life by mixing chemicals in a defined area.

Some of the greatest minds of mankind, such as Johann Wolfgang von Goethe in his book “Faust” dealt with the relationship of the individual to knowledge, death, and theology. The central theme of his play Faust is related to the fight of Faust who, blinded by the desire for the power, takes the role of devil creator creating alchemically the artificial being Homunculus. In the “Faust” Goethe deals with almost all the current issues of tissue engineering and medicine. According to Jung, such a story first appeared in the fifth century by Zosima from Constantinople, and the same legend appears with the Muslim alchemist Jabir ibn Hayyan (known in the West as Geber). Finally, the story of Frankenstein, written by Marry Shelley, also describes the visualization of creatures made from different parts of the body.

All these extraordinary examples show eternal desire of man to conquer immortality and to give the answer that gives hope to the eternal question of whether it is possible to overcome death and achieve eternity. Such topic from the legends and centuries of practical attempts to, if it is not possible to reach eternity, at least make life healthier and longer, still is here, as in all previous times. Artificial tissue substitutes in some kind of reconstructive medicine were used by the ancient Romans and Etruscans. There are written records related to the medical treatment of facial injuries before about 4000 years. Physicists of ancient India were using skin grafts in the reconstruction 800 years BC. Mechanical substitution of body parts with trying to replace teeth, nose and other parts of the body is described first by Ambroise Pare (1510-1590) in the book “De livres de la Chirurgie”. In the 18th century John Hunter, exploring the effects of transplantation on the clinical level, was the first to conduct implantation tests on animals, thus paving the way for transplantation medicine, and the famous surgeon Joahnn Friedrich Dieffenbach (1772-1847) experimented with skin grafts. He described his experimental and clinical attempts to transplant skin in the book “Regeneration et Transplantation”. Thus he became one of the founders of modern plastic and reconstructive surgery, and can be considered a pioneer in transplantation medicine. On the other hand,

Heinrich Christian Burger first performed a successful autologous transplantation of skin, while Esser (1877-1964) significantly improved facial reconstructive transplantation. The biological mechanisms important for the fate of the graft were first described by Rudolf Virchow (1821-1902) in his book "Cellulrpathology", indicating that tissue regeneration depends on cell proliferation. The cultivation of cells "in vitro" was discovered by R.G. Harrison (1870-1959), who showed active cell growth in the culture. Regenerative medicine and microsurgery are directly associated with "in vitro" cell culture with subsequent cell transplantation. Alexis Carrel (1873-1944) is considered the founder of modern organ transplantation due to his work on methods of vascular anastomosis. Microvascular surgery was first used for organ transplantation and plastic surgery. The development of the science of immunomodulation and immunosuppression was crucial for the application of tissue engineering and regenerative medicine.

However, organ transplantation and tissue engineering in the modern sense date only from 1980, or 1988. Just to notice, the term tissue engineering comes from 1980 and in the current meaning of from 1987. Progress in the field of organ transplantation and tissue engineering is directly associated with the development of clinical medicine (prosthetics, reconstructive surgery, transplantation medicine and microsurgery) and biology (cell biology, biochemistry, molecular biology, genetics). On the other hand, a key milestone in the development of nanotechnology and molecular engineering is related to the books: "There's Plenty of Room at the Bottom" by Richard Feynman, from 1959 and "Engines of Creation: The Coming Era of Nanotechnology" by K. Eric Drexler's from 1980, in which the implementation and implications of the application of nanotechnology and nanomachines in medicine were promoted and so the foundations of nanomedicine were laid.

Nanomedicine, understood in the broadest possible way, is a discipline which involves nanotechnologies and using all other sciences and knowledge makes space for better and healthier human life, and in some of its consequences related to the creation of machinery for repairing cells and nanorobots which perform different types of diagnostics and reparation in the body, it deals directly with the issues of life, its permanence, an eternity, as the central issues of human existence. It includes therapy and genetic manipulation, tissue engineering and therapeutic procedures, equipment and facilities for the treatment of serious diseases and thus becomes the central theme of the modern world.

Unlike other animals, we have the awareness of death, so that the origin of language, culture and religion is intrinsically linked to the breakpoint in the distant past, when our ancestors were for the first time aware of the terrible knowledge and the need to explain the meaning of their own life and death. The world of ancient times was the world of mythology and religion, which gave consolation and hope that the eternal life is possible. The dogmas of all big religions are based on the promise of eternal life. The man of the modern era is characterized by awareness that the old stories and dogmas of life and death cannot reheat his hope anymore. He doesn't believe anymore in myths, knows that he can never go back to the time of "innocent ignorance" and that he will never be returned to blissful Eden times, to not know what the death is, like other living beings. Today, more than ever, there is a need for a new story, real and true, which will help to restore hope and construct a world in which we live. Nanomedicine, as no branch of science, just today provides such an alternative. A step towards repairing damaged organs and their recovery to the original

state, with all its features is really promising. It is on the trail of human immortality, in which myth and legend come true.

Some scientists, futurists and philosophers, as Ray Kurzweil, argue that human immortality is going to be realistic during the first few decades of the 21st century, while others believe that a significant extension of life, as much more realistic goal, be safely realized; while for the winning immortality we still have to wait. The most optimistic among researchers such as Aubrey de Grey, a researcher who has developed many strategies of biomedical rejuvenation, believe that the cessation of further aging can be achieved in two to three decades, which will allow people biological immortality, but not the inviolability of physical trauma.

Aubrey de Grey has defined aging as a "collection of cumulative changes on the molecular and cellular level in the organism of an adult, which have resulted in important metabolic processes that occur normally until the amount of the change is not large enough to cause a change of metabolism, causing the pathology and death". The process of aging is related to the loss of cells, the nuclear oncogenetic mutations, extracellular aggregates, and chaotic cell connection, the drop of the immune system and endocrine changes. The elimination of the aging requires solution for each of the causes, in particular.

Biological immortality is the absence of aging. Accordingly, the cell or organism which does not experience aging or have ceased to age at some point, are biologically immortal. Biologists are trying to create a world of immortal cells design that are not limited by Hayflick's limit, in which the cells do not divide any more because of DNA damage or telomere shortening. Preventing the cells to grow old biological immortality is achieved. The cause of aging is related to the shortening of the telomeres, which are located at the end of the DNA. Telomerase is an enzyme that re-builds the telomer in stem cells and cancer cells, allowing it to be replicated any number of times. It can be used in human somatic cells to prevent healthy tissue to age.

Scientists hope to provide, together with stem cell growth, the growth of organs and transplantation of organ without risk of rejection. They believe also that the increase of the amount of naturally formed enzyme telomerase in the body can prevent the death of cells and thus lead to a longer and healthier life. Under normal circumstances, in the absence of telomerase, if a cell divides repeatedly, at one point all the progeny will reach the Hayflick's limit. In contrast, in the presence of telomerase, during the each cell division, lost part of cell DNA can be restored again, thus allowing the cell to divide indefinitely. Although this feature of telomerase is exciting for many researchers, it requires caution, because this unlimited growth is a step towards transformation of normal cells into the cancer cells, if the organism replicates cells in faster than it is theoretically necessary to stop aging. Another kind of immortality can be realized through technological immortality, which includes the strategy of serious life extension, enabled by the presence of many scientific procedures and new technologies: nanotechnology, genetics, biological engineering, regenerative medicine, microbiology, etc. An important aspect of this approach is a combination of the human clone, or cryonics nanotechnology, which play a key role in the extreme life extension. Robert Freitas, a theorist of Nanorobotics, suggests that the fine medical nanorobots will be created to move through the blood vessels, finding dangerous things like cancer cells and bacteria and destroy them. He supports the theory that it will be possible to continuously create biological and synthetic substitutes of parts in order to replace the damaged part. One idea is re-storing ("uploading") of personality

and memory through a direct interface between the computer and the mind.

This concept assumes that the individual memory can be upgraded to the mind of a newborn baby, as in the case of computer. The baby will then grow with its individual personality and with additional consciousness built into its memory. Futurists like Moravec and Kurzweil assume exponential growth of computer power in the future, which will at some time be able to accept human consciousness in a computer system, and live indefinitely with it in a virtual environment. This will be possible by applying cybernetic future, in which the computer will initially be installed in the human brain to help processes of sorting memory and accelerate its processing. The components will be added gradually to avoid sudden changes that might threaten an individual's identity. After that, the human body will be treated as part of the equipment (hardware), which enables the transfer of the mind within the memory of any computer with enough strength. Another possible mechanism for uploading of the mind is to make a detailed scan of the given individual, or his brain, and to simulate its conscious functions simulate inside the computer. What the level of scanning required to eliminate consciousness is, and what

kind of consequences would induce this kind of scanning, remains to be studied. Whatever, so uploaded mind would be immortal, free from the traumatic effects of machines, as in the previous procedures.

At the end, there is the ethical question: what does remain of us in this Faustian bargain with the devil?

Instead of conclusion

The monograph "Nanomedicine, the greatest challenge of the 21st century", written by V.Jokanović on 830 pages and published by DATASTATUS 2012, from 2012 to now is only professional book which is pronounced as the book of choice, arousing the attention that is typical for most read books in the field of literature and philosophy [1]. That was the reason, for writing of this short insight in this amusing book (Supplementary file).

Reference

1. Jokanović V (2012) *Nanomedecine, the greatest challenge of 21st century*. DATASTATUS, Belgrade.