Aging and Senescence

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Abstract: Aging is the process of becoming older. Aging in humans contains a multidimensional process of physical, psychological, and social change, which is an important part of all human societies reflecting the biological changes. It is possible to make the rejuvenation and extend a lifespan for animals and possiblly to achieve stop senescence, reverse aging or at least significantly delay it. In biology, the senescence is reasoned by the cellular senescence. A typical experiment is that we see limited ability to divide for the cells in culture. Why are there aging and senescence for the life biologically? There is no answer up to now.
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1. Introduction

Aging is the process of becoming older. Aging in humans contains a multidimensional process of physical, psychological, and social change, which is an important part of all human societies reflecting the biological changes. It is possible to make the rejuvenation and extend a lifespan for animals and possiblly to achieve stop senescence, reverse aging or at least significantly delay it (Ageing-Wikipedia, 2014).

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The following are some reasonable theories and factors related to the aging:

1. Evolutionary theories: The aging is an evolutionary reqiurement.
2. Telomere theory: Telomeres will be shorten with each successive cell division. Shortened telomeres activate a mechanism that prevents further cell multiplication.
3. Reproductive-cell cycle theory: Aging is regulated by reproductive hormones that act in an antagonistic pleiotropic manner via cell cycle signalling, promoting growth and development early in life to achieve reproduction, but later in life it becomes dysregulated and drive senescence.
4. DNA damage theory of ageing: DNA damage causes the cells stopping to divid or induce apoptosis.
5. Gene loss theory of ageing: All lifebodies lose DNA when getting old. DNA loss and damage are the central cause of aging.
6. Autoimmune theory: Aging results from an increase in autoantibodies that attack the body's tissues.
7. Mammalian target of rapamycin (MTOR) theory: MTOR, a protein that inhibits autophagy is linked to aging through the insulin signalling pathway. MTOR is a serine/threonine protein kinase that regulates cell growth, cell proliferation, cell motility, cell survival, protein synthesis, and transcription. MTOR belongs to the phosphatidylinositol 3-kinase-related kinase protein family.
8. Aging is programmed: An internal clock detects a time to end investing in the organism, leading to death. As in a clock, an ageing sequence is built into the operation of the nervous or endocrine system of the body. In rapidly dividing cells, shortening of the telomeres would provide such a clock.
9. Accumulative-waste theory: A buildup of body waste products interferes the metabolism.
10. Wear-and-tear theory: Body changes associated with aging are the result of chance damage that accumulates over time.
11. Error accumulation theory: The aging results from chance events that escape proof reading mechanisms, which gradually damages the genetic code.
12. Cross-linkage theory: The aging results from accumulation of cross-linked compounds that interfere with normal cell function.
13. Free-radical theory: The free radicals, or more generally reactive oxygen species or oxidative stress create damage that gives rise to the aging.

14. Misrepair-accumulation theory: The aging is the result of the accumulation of misrepair.
15. Reliability theory: Aging is a direct consequence of systems redundancy.

Senescence is the biological aging, the gradual deterioration of function characteristic of lifeforms. The senescence can be cellular senescence or whole organism senescence. The cellular senescence underlies organismal senescence. Senescence is not the inevitable fate of all organisms. In the human disease Syndrome X a person remains physically and mentally an infant or child throughout one's life. Biological aging and chronological aging are quite distinct concepts. Senescence could be programmed by gene expression changes, or the cumulative damage caused by biological processes. Whether senescence as a biological process itself can be slowed down, halted or even reversed, is a subject of current scientific speculation and research (Senescence. Wikipedia, 2014).

Cellular senescence is the phenomenon by which normal diploid cells cease to divide. In cell culture, fibroblasts can reach a maximum of 50 cell divisions before becoming senescent. This phenomenon is known as replicative senescence. Replicative senescence is the result of telomere shortening that ultimately triggers a DNA damage response. Cells can be induced to senesce via DNA damage in response to elevated reactive oxygen species, activation of oncogenes and cell-cell fusion.

Organismal senescence is the aging of whole organisms. In general, aging is characterized by the declining ability to respond to stress, increased homeostatic imbalance, and increased risk of aging-associated diseases. Death is the ultimate consequence of aging. Aging of whole organisms is a complex process that can be defined as a progressive deterioration of physiological function, an intrinsic age-related process of loss of viability and increase in vulnerability. Senescence may be the product of such selection.

Chronology is an effect of arranging events in their order of occurrence in time, such as a timeline or sequence of events. Aging is a biological chronological phenomena.

Apoptosis is the process of programmed cell death that occurs in multicellular organisms, where the biochemical events lead to characteristic cell changes and death that include blebbing, cell shrinkage, nuclear fragmentation, chromatin condensation, and chromosomal DNA fragmentation, etc. A cell initiates intracellular apoptotic signaling in response to a stress that brings cell suicide, etc. The binding of nuclear receptors by glucocorticoids, heat, radiation, nutrient deprivation, viral infection, hypoxia and increased intracellular calcium concentration, etc, which can arouse the damage of membrane to bring the release of intracellular apoptotic signals by a damaged cell. A number of cellular components such as poly ADP ribose polymerase regulates the apoptosis.

Turritopsis nutricula is a hydrozoan that can revert to the sexually immature (polyp stage) after becoming sexually mature. It is the only known metazoan capable of reverting completely to a sexually immature, colonial stage after having reached sexual maturity as a solitary stage. It does this through the cell development process of transdifferentiation. This cycle can repeat indefinitely that offers it biologically immortal. *Turritopsis nutricula* is a small (5 millimeters (0.20 in) species of jellyfish that uses transdifferentiation to replenish cells after sexual reproduction. This cycle can repeat indefinitely, potentially rendering it biologically immortal. This organism originated in the Caribbean sea, but has now spread around the world. To study the reason of the biological immortality of *Turritopsis nutricula* possibly supplies the way finding the biological immortality for human. *Turritopsis nutricula* is a species of jellyfish with a very unusual quality: it is biologically immortal. Also known as the immortal jellyfish, this fascinating animal, in theory, has the ability to sustain life indefinitely, so long as its nerve center remains intact. It does this through the cell development process of transdifferentiation. This cycle can repeat indefinitely tha offers it biologically immortal. It is not clear if stem cells are involved in this immortality or not (Ma and Yang, 2010).

Age is a major risk factor for most common neurodegenerative diseases, including mild cognitive impairment, Alzheimer's disease, cerebrovascular disease, Parkinson's disease and Lou Gehrig's disease, et al.

In the live bodies, DNA damage occurs frequently and DNA repair processes have evolved to compensate. In estimates made for mice, on average approximately 1,500 to 7,000 DNA lesions occur per hour in each mouse cell, or about 36,000 to 160,000 per cell per day (Vilenchik & Knudson 2000). In any cell some DNA damage may remain despite the action of repair processes. The accumulation of unrepaired DNA damage is more prevalent in certain types of cells, particularly in non-replicating or slowly replicating cells, such as cells in the brain, skeletal and cardiac muscle. DNA damages arouse the aging and senescence. The DNA damages include the oxidized nucleoside 8-hydroxydeoxyguanosine (8-OHdG), single- and double-strand breaks, DNA-protein crosslinks and malondialdehyde adducts, et al. The promoter sequences of some particular genes accumulated oxidative DNA damages with age. The DNA damage reduces the expression of selectively

vulnerable genes involved in moving, heart function, vessel, liver, and neuronal survival, initiating a pattern of whole body aging that starts early in life.

The longest-living person whose dates of birth and death were verified to the modern norms of Guinness World Records was Jeanne Calment, a French woman who lived to 122. The maximum life span for humans has increased from 103 in 1798 to 110 years in 1898, 115 years in 1986, and 122.45 years since Calment's death in 1997. Turritopsis nutricula reverts to a sexually immature stage after reproducing, rather than dying as in other jellyfish. Consequently the species is considered biologically immortal and has no maximum lifespan (Ma and Yang, 2010).

Different parts fo the human body aging questions:

Cardiovascular system:

During the aging, the heart rate becomes slower and heart becomes bigger. The blood vessels and arteries become stiffer and the heart works harder to pump blood through them. Hypertension (high blood pressure) and other cardiovascular problems will happen. The people need to do: Take physical activity in daily routine. Eat a healthy diet. Choose vegetables, fruits, grains, high-fiber foods and lean sources of protein. Control the foods with high saturated fat and sodium. Control the smoking if it is not neccesary for the lif ethe work. Control the stress.

Bones, joints and muscles:

With age, bones tend to shrink in size and density — which weakens them and makes them more susceptible to fracture, and it even becomes shorter. Muscles generally lose strength and flexibility, and becomes less coordinated or have trouble balancing. Normally take 1,000–1,200 milligrams (mg) of calcium a day. Dietary sources of calcium include diary products, almonds, broccoli, kale, canned salmon with bones, sardines and soy products, etc.. If cannot get enough calcium from the diet, take some calcium supplements.

Normally take 600-800 international units (IU) of vitamin D per day. Take physical exercise and control the smoking and alcoholic drinks.

Your digestive system

Constipation is more common in older adults. Many factors can contribute to constipation, including a low-fiber diet, not drinking enough fluids and lack of exercise. Use diuretics and iron supplements will help on the constipation. Eat a healthy diet. Control meats. Drink plenty of water and other fluids.

Your bladder and urinary tract

Loss of bladder control (urinary incontinence) is common with aging. To promote bladder and urinary tract health: Go to the bathroom regularly. Maintain a healthy weight. Control smoke.

Your memory

Memory tends to becomes less efficient with age. Eat a healthy diet. Choose low-fat protein sources, such as fish, lean meat and skinless poultry. Include physical activity in daily routine. Stay mentally active. Take part in social activities.

Gerontology is the study of the medical, physiological, biochemial, social, psychological, nursing, legal and biological aspects of aging. It is distinguished from geriatrics, which is the branch of medicine that specificlly studies the diseases of older adults. Gerontologists include researchers and practitioners in the fields of medicine, nursing, physiology, biology, biochemistry, molecular biology, dentistry, chemistry, social work, criminology, physical therapy, biogerontology, occupational therapy, psychology, psychiatry, sociology, economics, politics, architecture, geography, pharmacy, public health, housing, and anthropology, etc.

Rejuvenation is the aspect of the reversal of the aging process. Life extension is the contents on the causes of aging and work to oppose those causes in order to slow aging. Rejuvenation is the reversal of aging and thus requires a different strategy. Rejuvenation can be a means of life extension, but most life extension strategies do not involve rejuvenation. Eternal youth is the concept of human physical immortality free of aging.

Aging starts as soon as a living body is born. On the ends of each chromosome are repetitive sequences of DNA telomeres (to protect the chromosome from joining with other chromosomes). One of the DNA telomere's roles is to regulate cell division by allowing each cell division to take a small amount of genetic code off. The amount taken off varies by the type off cell being replicated. The slow wearing away of the telomeres restricts cell division to 40-60 times (Hayflick limit). Once this limit has been reached the organism will dies. The lengthen the telomeres is important to the lengthen the life.

About 90% of cancer cells contain large amounts of the enzyme telomerase. Telomerase is an enzyme that replenishes the worn away telomeres by adding bases to the ends and thus renewing the telomere. A cancer cell has in essence turned on the telomerase gene, and this allows them to have an unlimited amount of divisions without the telomeres wearing away. Other kinds of cells that can surpass the Hayflick limit are stem cells, hair follicles, and germ cells, etc, and they contain raised amounts of telomerase.

Plant senescence also exist as a process of

aging in plants. Plants, as other forms of organisms, have both unintended and programmed aging. Leaf senescence is the cause of autumn leaf color in deciduous trees.

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Discussion

Life is a physical and chemical process. From ontology aspect, the world is timeless and the life exists forever as any other body in the nature. The nature of life is that life is a process of negative entropy, evolution, autopoiesis (auto-organizing), adaptation, emergence and living hierarchy. Up to now, there is no scientific evidence to show that life body and non-life body obey the same natural laws. But, all the researches are made by the methods of biology, biochemistry and molecular biology, etc. It is very possible that the life and non-life are essential different in the biophysics, i.e. the quantum level. In the future, it is possible to make artificial life by either biological method or electronic technique. Life is unique in the known universe, which is in a diversity of forms ranging from bacteria to human. The life organisms exist in everywhere of the earth. The first forms of life on earth spontaneously arose out of a preexisting prebiotic chemical soup. Individual living organisms maintain their self-identity and their self-organization while continually exchanging materials and energy and information with their environment. It is really different between the life and non-life bodies, but nobody knows what the exact difference it is, even this is one of the most important issues that attracted people in the whole human history (Ma and Cherng, 2005).

Compared to aging, it is the immortality or eternal life, the life lives forever.

Immortality is eternal life or the ability to live forever. The biological forms have inherent limitations and It is a very important topic to see if the medical interventions or engineering can or cannot to overcome this limitation. Natural selection has developed potential biological immortality in at least one species, the jellyfish *Turritopsis dohrnii* (Ma and Yang, 2010). The withdraw of aging could provide humans with biological immortality, but not invulnerability to death by physical trauma, disease and hurt such as war.

Whether an immaterial soul exists and possesses immortality is an imtersting topic for both the science and religion or the mixture of science and religion.

Biological immortality is a stable or decreasing rate of mortality from cellular senescence as a function of chronological age. Some unicellular and multicellular species may achieve the immortality. A biologically immortal living being can still die from means other than senescence, such as through the injury or disease.

Immortal cell lines of cancer cells can be created by induction of oncogenes or loss of tumor suppressor genes. One method to induce immortality is through viral-mediated induction of the large T-antigen, commonly introduced through simian virus 40 (SV-40).

The elixir of life immortality was recorded in the philosopher's stone, which is a mythical potion that, when one drunk from a certain cup at a certain time, supposedly grants the drinker eternal life and/or eternal youth. Also, the elixir of life was said to be able to create life. Related to the myths of Thoth and Hermes Trismegistus, both of whom in various tales are said to have drunk the white drops (liquid gold) and thus achieved immortality. Alchemists in various ages and cultures in the world looked for the means of formulating the elixir. The ancient Chinese believed that ingesting long-lasting precious substances such as jade, cinnabar or hematite would confer some of that longevity on the person who consumed them. Gold was considered particularly potent, as it was a non-tarnishing precious metal; the idea of potable or drinkable gold is found in China by the end of the third century BC. The most famous Chinese alchemical book the Danjing yaojue discusses in detail the creation of elixirs for immortality including mercury, sulfur, salts and arsenic are prominent, and most are ironically poisonous. Many of these substances do not contribute to longevity but are actively toxic. In ancient China, many emperors looked for the fabled elixir with varying results. In the Qin Dynasty, Qin Shihuang sent Taoist alchemist Xu Fu with 500 young men and 500 young women to the eastern seas to find the elixir, but he never came back (It was said that they found and escaped to Japan and it was said that they were the ancestors of the Japanese). Jiajing Emperor in the Ming Dynasty died from ingesting a lethal dosage of mercury in the supposed elixir of life conjured by alchemists.

The panacea was supposed to be a remedy that would cure all diseases and prolong life indefinitely. It was sought by the alchemists as a connection to the elixir of life and the philosopher's stone, a mythical substance which would enable the transmutation of common metals into gold. The Cahuilla Indian people of the Colorado Desert region of California, according to legend, used the red sap of the elephant tree as a panacea medicine. The ginseng is Panax was widely used in Traditional Chinese Medicine as a cure-all medicine. A lot of information, theories and medical treatments about aging control in Chinses medicince,

which are still important in the modern life science.

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