Process of Aging -Part III-Cellular Senescence

From 1960 to 1990 the total US population grew by 30%, whereas the number of persons sixty-five years of age or older increased 89% and the number 85 years of age increased 232 %. (Bureau of Census. Current population report. 65 plus in America. Washington: US Government Printing Office; 1993).

In this series of articles, we have been describing the definable physiological parameters, which differentiate younger from older adults beyond actual age itself. In general, it appears that the process of aging involves a decline in the efficiency of various cells and tissues and systems. The real question is then what precipitates this decline in efficiency and can it be avoided. Memory impairment probably represents the most obvious change occurring both in the so-called physiological aging and in pathological aging.

One of the assumptions in biology is that normal cells can go through only a fixed number of divisions before they die, a process called senescence. The assumption leads to the conclusion that this accounts for the aging process. Harry Rubin, Professor of Molecular Biology at University of California, Berkeley wrote a review article in Mechanism of Aging and Development 1997; 98:1-35. The article entitled Cell aging in vivo and in vitro, presents evidence that cells "accumulate damage over a lifetime [that] results in gradual loss of differentiated function and growth rate". He rejects the notion of an intrinsic limitation of the number of cell divisions. It is the damage to cells over a lifetime that stimulates the effects of aging, which induces a gradual loss of differentiated function of the cells and growth rate. This stress (e.g. biochemical damage) on the cells reduces its capacity to multiply. It is not related to changes in hormonal states, blood flow or other system effects of aging. This is an important distinction for researchers to make in understanding what is aging. **Reduce "the stress" and you prolong life.**

Dr. Rubin believes that cells enter an altered stage of growth, due to stress, which renders them susceptible to cancer and other types of intrinsic events(caused or initiated by process that originates within the body) that can lead to death. Rubin states:"there is ample evidence for a decrease in stability of the genome with age which would help to account for the exponential increase in cancer with age. This does not rule out an additional need in many cases for multiple mutations to produce a fully autonomous cancer. More likely, both factors, and perhaps others, contribute to the age dependence of cancer incidence." What happens is that cells loss their capacity to control gene expression. It is this slowing down or loss that manifests itself as the aging process.

There are attempts by the body to deal with this process as result of the stabilizing feature of multcellularity in organs where metabolic cooperation among cells occurs. "Multicellularity also provides the opportunity for continuous selection of the least damage cells." (Rubin). The object then is to reduce the stress on cells to prevent the start of altered growth stages, manifested as aging.

It would seem that there is something in the architecture of the gene that relates in some way to longevity. Scientists have found that every chromosome has tails (telomeres) at its ends that get shorter as a cell divides. The telemere length is hypothesized to give some indication of how many divisions the cell has already undergone and how many remain before it becomes senescent. Is this the result of "stress" or a natural process? What would happen if we were able to stop this process? Continued cellular growth is seen in cancer where cells seem to be immortal. Is this the result of an abnormal gene product, telomere non-shrinkage, or other factors? Maybe if we understand the biochemistry of aging, we will have some of the answers, producing longer and healthier lives. The next part of this series will look at the healthy older person and what distinguishes that person from the rest of the population.

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