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Theory of reliability and aging: Teaching comes from Kyiv

Vitaly K Koltover
Russian Academy of Sciences, Russia

Biological systems perform their functions in the presence of a great number of random factors which disturb all functional strata. Therefore, similarly to technical devices, they are not perfectly reliable in operation. The field of systems biology, in dealing with the problem of reliability, incorporates theoretical and experimental studies of quantitative characteristics and mechanisms of failures and renewal processes. It also includes elaboration of methods for testing reliability and predicting failures. The regular conferences, which were initiated in Kiev, Ukraine, to deal with the problem of reliability of biological systems have given a strong impetus to research in this direction starting from 1975. It has spurred the similar studies on reliability on the other side of the former "iron curtain". The reliability problems are closely related with problems of resistance to deleterious environmental factors, including ionizing radiation, and aging. There are two generally known concepts in gerontology. Some men see things as the program of aging. Others see that the species life-spans vary in the inverse proportion to the species-specific metabolic rates and say that aging proceeds stochastically. The goal of this report is to show how both concepts may be integrated within the systems theory of reliability. The reliability approach developed in our papers bases on the simple general principles that (i) all biomolecular constructions are designed in keeping with the genetic programs in order to perform the programmed preset functions; (ii) all biomolecular constructions operate with the limited reliability, namely, for each and every bionanoreactor, normal operation acts alternate with accidental malfunctions; (iii) the preventive maintenance, i.e., timely replacement of unreliable functional elements, the metabolic turnover prophylaxis in cells and tissues, is the main line of assuring the high systems reliability; (iv) there is the finite number of critical elements which perform the supervisory functions over the preventive maintenance; (v) the "supervisors" also operate with the limited, preset, reliability . On this basis, the universal features of aging, such as the exponential growth of mortality rate with time and the correlation of longevity with the species-specific resting metabolism are naturally explained. The stochastic malfunctions of the mitochondrial electron transport nanoreactors that produce oxygen anion-radicals (O_2^-) seem to be of first importance. As the reducing agent, O_2^- is capable to affect the ratio of NADH/NAD^+ and, by changing the activity of sirtuins, slow down the renewal of biomolecular nanoreactors. Basing on the reliability-theory approach, one can estimate that the longevity of human brain could reach 250 years should the antioxidant defense against the free-radical failures be perfect. Thus, aging inevitably occurs as consequence of the programmed, genetically preset, deficiency in reliability of the biomolecular constructions while the free-radical timer serves as effective stochastic mechanism of realization of the program. Furthermore, the systems reliability approach provides heuristic methodology for the novel preventive medicine including new anti-aging and anti-radiation protectors based on the stable magnetic isotopes.

koltover@icp.ac.ru

Elderly onset rheumatoid arthritis

Tripti Papneja
William Osler Health System Foundation, Canada

Given the increased frequency of rheumatoid arthritis with increasing age, it is important for physicians to be able to recognize distinguishing features of RA from other rheumatic diseases in elderly patients such as polymyalgia rheumatic, RS3PE, pseudogout and osteoarthritis. Moreover, this talk would also highlight the differences in clinical characteristics of young onset rheumatoid arthritis (RA) as compared to elderly onset RA. Managing cardiovascular comorbidities, vaccination issues and bone health in elderly patients with RA would also be discussed.

Papneja@ualberta.ca