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The Aging Process

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The Aging Process

INTRODUCTION

A century ago, the aging process was looked upon as a philosophical rather than a medical issue.¹ With better sanitation and advances in the prevention and treatment of disease, however, life expectancy has improved, and the diseases associated with aging are no longer considered inevitable.

The United States is now faced with the problems of an aging society caused by the increasing number of older adults, born during the “baby boom” years of 1946 to 1964. Currently, persons older than 65 years account for 13% of the United States population of approximately 270 million. Aging trends predict that this older age group will account for 24.6% of the population by the year 2020.^{2,3} It is important that we understand the physiology of aging and distinguish processes related to age from those related to disease.

DEFINITIONS

Aging is a time-related process. For example, a toddler ages toward adolescence. *Senescence* refers to the “postmaturation processes that lead to diminished homeostasis and increase vulnerability of the organism.”⁴ It is important to differentiate normal aging from usual aging. *Normal aging* involves progressive and inevitable changes related to physiologic processes and not those from disease (eg, menopause). *Usual aging* is associated with age-related diseases that affect older adults (eg, coronary artery disease).^{4,5} The focus of this review is normal aging.

Life expectancy, or *average life span*, refers to the age attained by 50% of a population. In humans, as in many species, life expectancy of females is greater than that of males. Currently, life expectancy at birth in the United States is 80.2 years for females and 73.2 years for males; at age 65 years, it is about 20 years for females and 16 years for males.^{4,5}

The *maximum life span potential* is the age attained by the longest-lived member of a given population. The longest-lived human, properly documented, was 122 years old. Although the maximum life span potential of humans has remained relatively constant, life expectancy has progressively increased over the past century or more.

THEORIES OF AGING

For years, researchers have searched for explanations of the aging process. Several theories have been offered, most of which are speculative.

Stochastic Theories

Stochastic theories propose that the accumulation of random damage to vital molecules (eg, DNA, proteins) causes progressive functional decline and eventual death. These theories include the somatic mutation/DNA repair theory, the error catastrophe theory, the protein modification theory, and the free radical/mitochondrial DNA theory.

Genetic Theories

Genetic theories state that genetic material programs an individual’s growth from birth to death. These theories hold that longevity genes determine a particular species’ maximum life span potential. In humans, the ApoE4 allele of apolipoprotein E (ApoE) is correlated with decreased longevity, whereas the ApoE2 allele has been identified in centenarians.

Genetics play a role in accelerated aging syndromes such as Werner’s syndrome (adult progeria), Hutchinson-Gilford syndrome (childhood progeria), and Down syndrome. Recent research comparing healthy persons to children with progeria suggests that aging is related to errors in mitosis.⁶

Other Theories

The neuroendocrine theory suggests that the hypothalamus-pituitary-adrenal axis regulates physiology of growth at various stages; for example, pubertal and menopausal changes are brought about by neuroendocrine effects on the gonads. The immunologic theory proposes that aging is related to a decline in function of the immune system. Alterations in the immune processes increase susceptibility to disease and affect longevity. Environmental factors (eg, ionizing radiation) have also been incriminated in the aging process.

CHANGES ASSOCIATED WITH AGING

Aging is a physiologic process characterized by histologic and biochemical changes, functional changes in