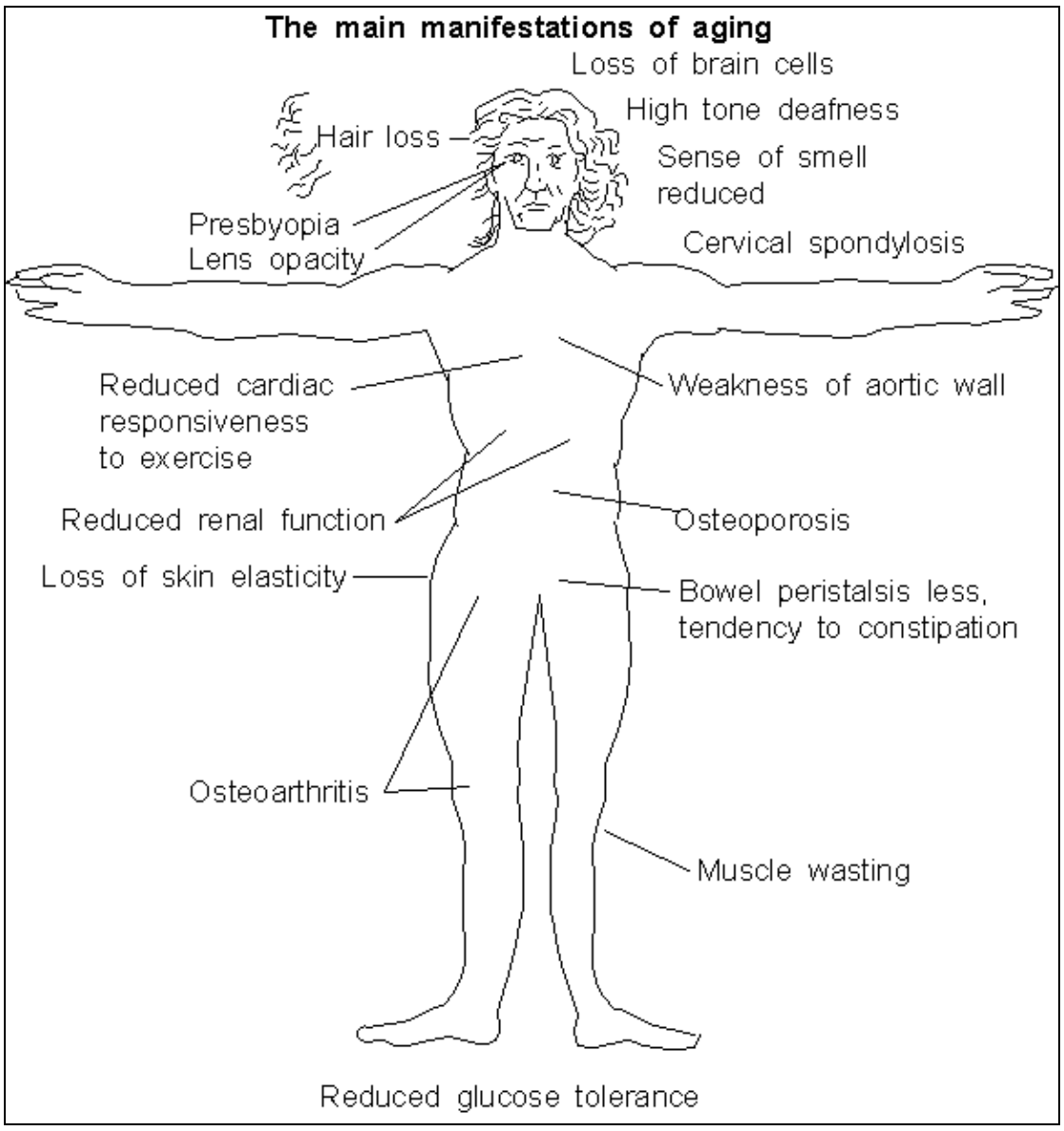
AGING

The precise definition of aging is problematic, largely because it is difficult to disentangle effects of nature (genetic) and of nurture (environmental). Aging can be defined is a decreased ability to maintain ideal homeostatic control in the absence of specific diseases. Aging as thus defined is a general, slowly progressive, process with loss of previous functional levels. It appears to be a syndrome that occurs in all multicellular organisms that reproduce sexually.

Currently life expectation is about 75 years whereas life expectation in the Middle Ages in Europe was 33 years. The increase is mostly attributable to reductions in:

- Neonatal mortality
- Infant mortality
- Deaths of mother in childbirth
- Death of babies during birth

Males have a lower life expectation, starting even before birth. Although about 170 males are conceived for every 100 females, two thirds of intrauterine deaths are in males and the sex ratio at birth is 106 males to 100 females.



THEORIES OF AGING

Free radicals

Metabolism involves the breaking down of molecules into their constituent radicals (molecules which contain unpaired electrons). Normally radicals combine rapidly and are not harmful. However many metabolic processes involve the production of imbalances leaving such radicals, particularly oxidising radicals, free to interact in an uncontrolled fashion to cause cumulative damage "aging." Antioxidants such as vitamin E reduce the incidence *of diseases* including cancer, Alzheimer's disease (senile dementia) and cardiovascular problems in animals but do not seem to affect non-specific aging processes.

Exhaustion of vital substances

An attractive theory but no "vital substances" have been identified.

Programmed cell death (apoptosis)

Cell division occurs throughout life except in highly differentiated cells such as nervous tissue. Normal cell in cell cultures divide about 50 times and then die out. This suggests that, even if all diseases entered on death certificate were conquered, we would all perish of old age at about 150 years of age. The only potentially immortal cell cultures are those that divide continually and notably include cancer cells.

Reproductive exhaustion

The effort of reproduction is in some way deleterious.

Genetic mutations

Genetic factors influence life span. Identical twins on average die within three years of each other whereas fraternal twins die within six years of each other. Certain animals, notably some types of worms, have been bred for longevity and the genes responsible have been identified. It is uncertain whether there is a genetically programmed accumulation of defects which results in an approximately defined life span. Telomeres are areas at the end of chromosomes which are formed by repetitive DNA sequences which reduce with each cell division and are thus associated with aging. A telomere making enzyme (telomerase) exists but it is unknown whether reconstitution of telomeres would delay aging.

Random events

The cumulative effect of a lifetimes' multiple, individually insignificant, events results in eventual malfunction of the whole organism.

Rate of living

There is some evidence that those who lead a stressful life die younger "burnout," but, if this is so, it is unclear whether this is a result of or a cause of aging.

Fixed clock

This is a combination of the apoptosis and rate of living theories. The nature of the clock has not been identified. It has been suggested that there are "limiting numbers for a lifetime" (for example of heart beats or respirations) but there is no convincing evidence. Bats and birds live at an exceptional metabolic rate but live a disproportionately long time for their size.

Second law of thermodynamics

"Everything wears down given time" is a Law of Nature.

Waste product accumulation

There is no evidence that multiple small accumulations of waste products cause morbidity or mortality (except in the case of defined organ failures which produce large accumulations of waste products).

Immune system dysfunction

Accumulation of intrinsic or environmental factors (e.g. radiation) reduces effective immunological surveillance of body cells and this produces abnormal "aging" reactions.

How could we prolong out life expectancy by reducing aging and/or diseases which may affect the aged?

- Have parents who, baring accidents, lived longer
- Eat less. Rats whose calorie intake is 30-40 percent less than free feeding controls live up to 40 percent longer. Humans are not rats but most people who live to a great age are thin
- Exercise more. Exercise can postpone or reduce heart attacks, non-insulin dependent diabetes mellitus, and hypertension. The problem is that to add n years of life it is necessary to spend n years of life exercising
- Do not smoke
- Drink moderately
- Eschew hypertension and diabetes
- Take various drugs to prevent various diseases