Old age and aging

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Aging

- All-time related process
- Senescence = deteriorative changes during postmaturational life
- Process that increases vulnerability and decreases the likehood of survival

Old age:

- Absolute determination
- Old age is starting at age of 65 years

- **65 – 74 years:** problems of retirement, lesure time, activities
- **75 – 84 years:** problems of maladaptation, disease, social isolation
- **Above 85 years:** problems of self-sufficiency and nursing care

Geriatric medicine

- geron = old man, iatreia = treatment process
- Problematics of aging and old aging, differences in incidence, clinical features, assessments and treatment in old age
- Internal medicine with overlap to neurology, urology, rehab and psychiatry

Demographic trends

- Lower birthrate x lower mortality in all age groups
- Longer life expectancy
- More old and very old people in population – 18.6% over 60 years, 13.9% over 65 years)

Life expectancy

- possibility to compare level of living

country	year	e0 women	e0 men	e65 women	e65 men
Japan	2004	85,0	82,0	22,0	17,1
Norway, Sweden	2004	83,6	77,9	19,9	16,2
Iceland	2003	82,3	76,4	19,5	16,2
Botswana	2004	38,7	35,8	N/A	N/A
Lituania	2003	75,9	65,7		
Czech rep.	2005	79,1	72,9	21,7 **e60**	17,8 **e60**
Czech rep.	2013	84,2	80,6	19,2 **e65**	15,6 **e65**
Russia	1995	71,7	58,3	14,9	10,8

Life expectancy

- Longer for women
- = higher rate of men´s mortality
- Problem of widowed old women (women of age 70 – 79 years 58%, men 15.3%; women above 80 years 81.5%, men 32.5%)
- Life expectancy is getting longer since ancient era:
  - ancient Egyptian, Rome 25 - 30 years,
  - Renaissance 35 years,
  - 2nd half of 19th century 41 years

Ageing

Velocity of ageing process is controlled by:

- Genetic predisposition
- Environmental factors - can influence genetic predisposition in positive or negative way, half of death causes is in connection to modified risk factors

Ageing process theories:

- Somatic mutation theory – genetic damage from enviromental insults, predominantly radiation, produces mutation in DNA, inactivation of any part could cause failure in function
- DNA repair theory – proposes that the inability to repair DNA damage is responsible for age-related effects (higher rate of cancer, kidney disease)
- Cross-linking theory – alterated macromolecules can impair normal cellular function
- Glycosylation theory – binding the glucose molecule; AGEproducts formation is leading to error accumulation and cytokine production (collagen, crystallin in eye lens)
- Free radical theory – most aging changes are due to molecular damage created by highly reactive chemical species that contain an unpaired electron

Ageing process theories part 2:

- **Neuroendocrine theory** – regards functional decrements in neurons and associated hormons (hypothalamic-pituitary-adrenal axis) as central to the ageing process (programmed theory similar to growth, puberty, reproduction…)
- **Immunologic theory** – based on observation that the immune system function declines with age – decreased response of T cells
- **metabolic rate theory** – the life span across the species would be inversely proportional to metabolic rate (smaller animals have higher metabolic rate and shorter life span than bigger) or heart rate etc…(x : bats have both long lives and high metabolic rate, marsupials have short lives and low metabolic rates…)

Lipofuscin

- Fallow pigment = „age pigment“
- Accumulated in cells (neurons, myocyts ♥)
- Changes enzymatic activity of the cell, leads to cellular death
- Result of macromolecule oxidation

Glycosylation

- nonenzymatic reaction among proteins and glucose, no energy requirement
- AGEs – advanced glycosylation endproducts
- Reacts with tissues, RAGE (receptors for AGE) - leucocytes, mesangial cells, endotelial cells – cytokine production (TNFα, interleukin 1, IGF-1), free radicals formation (↑ 50x)
- Important aging agent (DM!!)

Progeria and progeroid syndroms:

- Premature aging – hereditary syndromes and progeroid syndromes; important models for ageing process studying
- **Hutchinson-Gilford syndrome** (progeria or „progeria of childhood) – rare, genetical deffect of hyaluronic acid metabolism; is characterized by profound growth retardation, sparse hair and subcutaneous fat, skin atrophy, atherosclerosis and death at a median age of 12 by myocardial infarction or congestive heart failure
- **Werner syndrome** – („progeria of adulthood“) premature graying and loss of hair, thinning of the dermis, loss of subcutaneous fat, bilateral cataracts, osteoporosis, arteriosclerosis in young adults, increased incidence of cancer

Progeria and progeroid syndroms:

- **xeroderma pigmentosum** – skin and brain affection, caused by UV radiation
- **Huntigton chorea** – brain affection, autosomal dominant heredity
- **Down syndrome** – trisomia of chromosome 21, premature graying and loss of hair, hypogonadism, altered distribution of subcutaneous fat, hypotonia, premature lipofuscin deposits, cataracts and neurodegeneration. High mortality rates secondary to infections and malignancies may be related to immune dysfunction. Chr.21 – contains genes for free radical scavenger superoxiddismuthase and β-amyloid precursor protein (βPP) – these changes result in overexpression of βPP, the amyloid is found in brain plaques and blood vessel and may cause the dementia.
- **DM** = progeroid disease - ↓ life span about ⅓, atherosclerosis akceleration, ↑ free radicals production, AGEs

Physical changes in aging:

- ↓ **body height** - ↓intervertebral plates, vertebral compression, muscle unbalance leading to round-schouldered position
- ↑ **BMI** until 7th-8th decade, then decline, ↓ active muscle mass (sarcopenia), ↑ of fat
- **Face changes** – virillisation of women (influence of adrenal androgens), feminisation of men (lack of androgens and abundance of estrogens), elongation of ear-lobes, enlargement of apex nasi, elongation of faces and eye lids
- **Skin changes** – face-lines, graying and loss of hairs, changes in subcutaneous fat distribution, skin atrophy, lipofuscin deposits

Physical changes in aging part 2:

- **arcus senilis** corneae
- **loss of teeth**
- changes in **gait and body pose**
- disturbances of **focusing**, **refraction, visual acuity and colour vision**
- ↓ **auditory acuity,** ↓ **touch,** ↓ **olfaction**
- ↓ **taste**, more in smokers
- **psychological aspects -** depression, dementia
- Changes in respiratory system – lower elasticity of airways, worse cough reflexes, mucus stagnation – more prone to respiratory infection

(Shakespeare: „old age = 2nd childhood – without eyes, without teeth, without everything“)

function	%	function	%
nerve conduction velocity	90	nerve rate	63
weight (men)	88	vital lung capacity	56
basal metabolism	84	myodynamia	55
total body water	82	brain weight	56
brain blood perfusion	80	kidney perfusion	50
cardiac output	70	touch-corpuscle rate	36
glomerular filtration	69	**ability to correct acidosis**	17

Changes in % comparison of the age 75 years with age of 30 years

Healthy and functional status assessment in old age:

- **subjective** evaluation of health and ability, quality of life – individual differences
- **activities of daily life** – mobility, toilet use, feeding, dressing, bathing, transfer between bed and chair. Instrumental activities of daily living – shopping, travelling, telephone use, meal preparation, medication administration, financies, laundry
- **Fitness assesssment** – bicycle ergometrie, hand grip
- **Specific markers assessment** – gait velocity, hand grip, balance testing, getting up the chair velocity
- **Mental status**

Functional geriatric examination

- **Complexed examination of:**
  - **health status,**
  - **physical performance and self-sufficiency,**
  - **mental function and**
  - **social situation**

1) Health status, risks, comorbidities

Target on: examination of vision and hearing, incontinency, balance and gait disturbances, malnutrition, evaluation of used therapy**!** **(effectiveness and safety)!**

Functional geriatric examination

2) Physical performance + self-sufficiency

-ADL = activity of daily living test (Barthel´s test)

Ability of eating, drinking, dressing, personal hygiene, incontinency/continency, toilet use ability, transfer from bed to chair, velocity of gait (corridor and up-stair walk)

From 0 to 100 points (from total dependency to self-sufficiency)

Functional geriatric examination

IADL = instrumental activities of daily living test

(use of phone, transportation, shopping, cooking, medication preparation, financies….) 40-100 points.

3) Mental health and psychological

Dementia – MMSE (Mini Mental State Examination)

Examination of basic cognitive function – memory, vigilance, expressions and practical abilities

0-30 points, less than 24 points = shortage of cognitive function

Functional geriatric examination

4) Social status, family, financies

Assessment of social situation, contact to family members, type of living, risks of housing, necessity of social help

Functional geriatric examination is important for evaluation of proper therapy, recommendation of compensatory aid, social services or recommendation of institutional care

Chronic diseases prevalence:

- 95% of men and 97% of women above the age of 60 years suffer from any chronic disease
- **multimorbidity** is typical for old age
- total prevalence of chronic diseases above the age of 60 is 2830/1000 persons
- cardiovascular diseases 77% (**hypertension** 51%, **CAD** 37%)
- **locomotive organs** disturbances 42%
- metabolic diseases 30% (**DM, dyslipidaemia**) above the age of 60 years

Different clinical presentation

- Microsymptomatology = minimal clinical presentation (absence of fever)
- Mono- or oligosymptomatology
- Non-specifical symptoms
- Atypical drug reactions
- Sudden worsening of health status – very low functional margin, low capacity to balance

FRAILTY syndrome

- Syndrome of geriatric fragility
- Physical and psychological changes
- **Mental changes** (apathy, subjectively perceived fatigue, exhaustion)
- **Mobility changes** (hypomobility, very slow gait, instability, falls) – the reason could be sarcopenia
- **Nutritional changes** (non-expected weight loss more than 4.5 kg/year)

- **= the person finds himself (herself) to be very sick x no objective signs of disease**

FRAILTY syndrome - treatment

- Claude Richard:
- „Bed is so dangerous for a senior patient as the Ferrari for a teenager“

- Treatment:
- motivate and move them to eat and to walk = rehab and nutrition

Pharmacotherapy in old age

- Changes in pharmacokinetics and pharmacodynamics – changes in drug effect (↓blood flow in GIT, ↓ motility of GIT, ↓ kidney function, changes in tissue sensitivity)
- More side effects
- More people are non-compliant
- More drug interactions

The most frequent side effects

- Ortostatic hypotension (antihypertensives, pain killers)
- Risk of extrapyramidal symptomatology (haloperidol, metoclopramid)
- Decrease in cognitive function, depression, delirium (tramadol, levodopa, indomethacin, teofyllin)
- Constipation
- Urine incontinence

Most frequent treatment problems

- **Drug-drug** interaction
- **Drug-disease** interaction (betablockers and heart conductive system)
- **Drug-food** interaction (warfarin+vit K)
- **Polypragmasia** = more than 4 drugs without indication
- **Polypharmacotherapy** = many drugs needed = high risk of interaction
- **Underprescription** = less medication than necessary (less pain killers, anticoagulation…)
- Rationale for pharmacotherapy in old age: **Beer´s criteria (1993, 2003), Start-stop criteria (2007)**

Rationale for pharmacotherapy in old age

- Minimum of drugs
- Use non-pharmacological treatment
- The lowest dose that is effective
- „ start slow – go low“
- Remember drugs side effects
- Remember drug interactions

Interventions in the ageing process:

- **Physical activity** – influences metabolism, muscle mass and function, cardiovascular function, prevent muscle mass loss
- **Dietary therapy** – caloric restriction – the best 30-60% energy restriction = best results = observational studies suggest a reduced mortality with low-calorie diet or low body-mass index
- **vitamins, phytopharmacological agents** (ginseng, ginkgo biloba), procain
- **Antioxidational drugs** – vit E,C
- **Hormonal therapies** – postmenopausal estrogen replacement, testosteron replacement in elderly men, melatonin replacement