Physiology 435 team

AGING AND CHANGES IN THE BRAIN

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SUMMARY:

1. definition of aging

Progressive, universal decline, first in functional reserve and then in function that occurs in organisms over time. It is not a disease; however, the risk of developing disease is increased, often dramatically, as a function of age.

It is characterized by:

- Changes in appearance (gradual reduction in height and weight loss due to loss of muscle & bone mass).
- A lower metabolic rate
- Longer reaction times to any stimulus
- Declines in certain memory functions
- Declines in sexual activity and in women menopause
- A functional decline in audition, olfaction, and vision
- Declines in kidney, pulmonary & immune functions, declines in exercise performance & multiple endocrine changes

2. terms of aging

Universal ageing → all people share	**Probabilistic ageing** → happen to some (type 2 diabetes)
Chronological ageing → how old a person is	**Biological ageing** → organism's physical state as it ages
Social ageing → society's expectations of how people should act as they grow older	

3. theories of aging

Genetic Aging is a genetic program activated in post- reproductive life when an individual's evolutionary mission is accomplished	**Oxidative stress** Accumulation of oxidative damage to DNA, proteins, and lipids interferes with normal function → ↓ in stress responses
Hormonal change The decline and loss of circadian rhythm in secretion of some hormones produces a functional hormone deficiency state	**Mitochondrial dysfunction** A common deletion in mitochondrial DNA with age compromises function and alters cell metabolic processes and adaptability to environmental change
Telomere shortening A decline in the ability of cells to replicate	**Defective host defense** The failure of the immune system to respond to infectious agents and the overactivity of natural immunity create vulnerability to environmental stress
Accumulation of senescent cells Renewing tissues become dysfunctional through loss of ability to renew	

4. aging nervous system

Cognitive changes in aging "mental processing"	changes	consequences
↓ (Sensation + attention + perception) → • ↓ decision making & execution • ↓ working memory)	↓ brain weight ↓ Cerebral blood flow Memory / Alteration in CNS NTs ↓ Vibratory sense	Drug toxicities Delirium / Altered mood IQ scores "benign senile forgetfulness" ↑ Postural instability / Altered gait / Falls & Accidents

Structures	Regional function	Structures	Regional function
Basal ganglia	Becomes bright in appearance due to iron accumulation	**Subarachnoid space**	↑ in size due to brain shrinkage
Hippocampus	↓ in size due to cell loss in the structure	**Ventricles**	↑ in size due to brain shrinkage
White matter	↓ in size due neuronal atrophy in the deep brain	**-**	-

in aging brain

- There is loss of dendritic arborization
- Recall memory (working/short-term) is affected more than cognitive function in normal aging
- Average amount of brain protein is reduced with a marked loss in multiple enzymes (carbonic anhydrase and the dehydrogenases) but with a relative increase in abnormal proteins such as amyloid in tangles and plaques.
- Loss of RNA (messenger and transcription) but not DNA
- Loss of lipids, and lipid turnover rate, and a decrease in catabolism and synthesis.
- Neuronal loss is normal in the aging brain but the ability to learn remains generally unchanged
- Cerebral atrophy shows up on CTs and MRI scans
- Reduced Sympathetic nervous system activity + Reduced Neurotransmitter levels
- Changes in sleep patterns + abnormalities in EEG tracing
- Increased risk of stroke

5. abnormalities

Alzheimer's disease

It is a premature aging of the brain, usually beginning in mid-adult life and progressing rapidly to extreme loss of mental powers similar to that seen in very, very old age

Features:

- An amnesic type of memory impairment
- Deterioration of language + visuospatial deficits
- Motor and sensory abnormalities, gait disturbances, and seizures are uncommon until the late phases of the disease.

Amyloid plaques between neurons "hallmark of Alzheimer's disease"

Amyloid is a general term for protein fragments that the body produces normally. Beta amyloid is a protein fragment snipped from an amyloid precursor protein (APP). In a healthy brain, these protein fragments are broken down and eliminated. In Alzheimer's disease, the fragments accumulate to form hard, insoluble plaques.

Neurofibrillary tangle

These are insoluble twisted fibers found inside the brain's cells. Consist primarily of a protein called tau, which forms part of a structure called a microtubule. The microtubule helps transport nutrients and other important substances from one part of the nerve cell to another. In Alzheimer's disease, the tau protein is abnormal & the microtubule structures collapse.

Presbyopia

Loss of ability to see items that are close up begins in the 40's.

- Size of pupil grows smaller with age: focusing becomes less accurate
- Lens of eye yellows making it more difficult to see red and green colors
- Sensitivity to glare increases
- Night vision not as acute

Pain and sense of touch

With age, skin is not as sensitive as in youth. Contributing factors include:
1. Loss of elasticity 2. Loss of pigment 3. Reduced fat layer

Safety Implications:

Lessened ability to recognize dangerous levels of heat
Lessened ability of body to maintain temperature

Geriatric syndrome

Dementia + Delirium + Falls + Urinary Incontinence + Pressure Ulcers + Functional Decline

- Dementia: progressive decline in which multiple intellectual abilities deteriorate, causing both cognitive and functional impairment
- Delirium: acute state of confusion, it may be the only manifestation of a life-threatening illness in the older adult "altered cerebral blood flow"

Carotid sinus hypersensitivity (baroreceptor reflexes)

- Carotid sinus syncope occurs when there is exaggerated vagal response to carotid sinus stimulation. Carotid sinus syndrome occurs in the elderly and mainly results in bradycardia.
- Provoked by wearing a tight collar, looking upwards or turning the head & messaging
- Most common etiologies of atrioventricular block

Sensorineural hearing loss

Damage to the hair cells of the organ of Corti may be caused by intense noise, viral infections, ototoxic drugs, and aging

Disorders of the sense of taste

Caused by: transport loss / sensory loss / neural loss
Sensory gustatory losses are caused by inflammatory and degenerative diseases in the oral cavity and aging

Sexual dysfunction

Erectile dysfunction (ED) is not considered a normal part of the aging process. Nonetheless, it is associated with certain physiologic and psychological changes

Tendency to develop bruises, skin tears more easily	related to age

Check your understanding!

1-"age changes that may happen to some" is a definition of which of the following:		2- all of the followings are theories of aging EXCEPT:	
A	biological aging	A	oxidative stress
B	chronological aging	B	genetic
C	probabilistic aging	C	telomere shortening
D	social aging	D	consequence loss height
3- what is the most cause of death in 65+ year old?		**4- what happens to hippocampus as the person grows up?**	
A	cancer	A	increase in size due to brain shrinkage
B	heart disease	B	reduction in size due to cell loss in structure
C	chronic respiratory	C	reduction in size due to neuronal atrophy in deep brain
D	stroke	D	becomes bright in appearance due to iron accumulation
5- all of these changes happen in aging EXCEPT:		**6-recall memory is ……. than cognitive function in normal aging.**	
A	loss of DNA	A	affected more
B	loss of RNA	B	affected less
C	increase cerebral amyloid	C	both are affected
D	reduce brain protein	D	both are not affected
7- what do we see in alzheimer patient?		**8- what is the hallmark of alzheimer diease?**	
A	neurofibrillary tangles	A	amyloid plaques
B	amyloid plaques	B	neurofibrillary tangles
C	severe cortical shrinkage	C	lewy bodies
D	all of the above	D	cortical shrinkage
9-neurofibrillary tangles consist primarily of:		**10- old people have …….. in their baroreceptors?**	
A	amyloid protein	A	hypersensitivity
B	tau protein	B	hyposensitivity
C	hard plaques	C	

D	amyloid precursor protein	D	
11-"farsightedness caused by loss of elasticity of the lens of the eye, occurring typically in middle and old age" is a definition of?		**12-true or false: "skin is more sensitive in old people than young people".**	
A	myopia	A	true
B	hypermetropia	B	false
C	astigmatism	C	
D	presbyopia	D	

Answers :

1- c	2- d	3- a	4- b	5-a	6- a	7- d	8-a	9-b	10- a	11- d	12- b