Aging & Brain

Objectives:

- ***Define Aging***
- ***Enumerate theories of aging***
- ***Describe body and brain changes in aging***
- ***Describe memory changes in aging***
- ***Explain carotid hypersensitivity***
- Disorders of the senses that associated with aging
- Brief Geriatric Assessment Instruments

Bold & Italic objectives are included in the medical education guide

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Colour index:
important
Numbers
Extra

Editing file

وَأَن لَّيْسَ لِلْإِنسَانِ إِلَّا مَا سَعَىٰ

❖ Terminology

Term	Definition
Universal Aging	Changes everybody shares.(e.g.Grey hair & wrinkles)التغيرات اللي ممكن تحصل لكل احد بالعالم
Probabilistic Aging	Changes that may happen to some. (eg type two diabetes).ممكن تحصل ممكن لا بس كثير نشوفها بالكبار
Chronological Aging	Degrees of aging.(eg 50 decades different from 80).
Social Aging	Society's expectations of a person's behavior as they grow older. يعني تأثير المجتمع , مثلاً في المجتمعات العربية ممكن الوحدة تصير جدة وعمرها لم يتجاوز الـ35 فتحس نفسها عجزت , مع لو أنها أجنبية ممكن تكون ما تزوجت للحين.
Biological Aging	Physical state of a person when he ages (Changes in tissues,heart,liver...)
circadian rhythm	biological process that displays an endogenous, entrainable oscillation of about 24 hours.
senescent cells	Cells that can't divide
visuospatial deficits	inability to judge the spatial orientation of objects or lines in space.
Alzheimer's Disease	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.
Dementia	is a syndrome of progressive decline in which multiple intellectual abilities deteriorate, causing both cognitive and functional impairment.هنا كل وظائف الدماغ تبدأ تقل شوي بحيث كل سنة تقل أكثر من السنة التي قبلها (الخرف
Delirium	is an acute state of confusion, Delirium may be the only manifestation of a life-threatening illness in the older adult. يصبح لديه لحظة توهان فلا يستطيع تمييز أي شيء لكنه في فترة قليلة (acute) غالبا يكون بسبب مشكلة في ال circulation cerebral example: cerebral stroke

❖ Define Aging

Aging
is the progressive, universal decline first in functional reserve and then in function that occurs in organisms over time.

Aging is **not** a disease; however, the risk of developing disease is increased, often dramatically, as a function of age

"Every organ in our bodies has capability and number of cells more than we need(functional reserve), so when we get (infection,stress,disease) day by day the functional capacity and the cells of the organ decrease, but it doesn't affect us because we have more than we need! مثلا نقدر حتى نتبرع بالكلية وكل شيء تمام مانتأثر
As we get old changes in the function itself occur day by day".كانت اكثر من اللي نبيه ووصلت لأقل من اللي نحتاجه

AGEING IN THE DEVELOPMENT AGENDA

"Ageing is a development issue. Healthy older persons are a resource for their families, their communities and the economy."
الجدات والجدان اللي بصحة كويسة نشوف قد ايش هم مفيدين للبيت اللي هم فيه

SUCCESSFUL AGING happens when

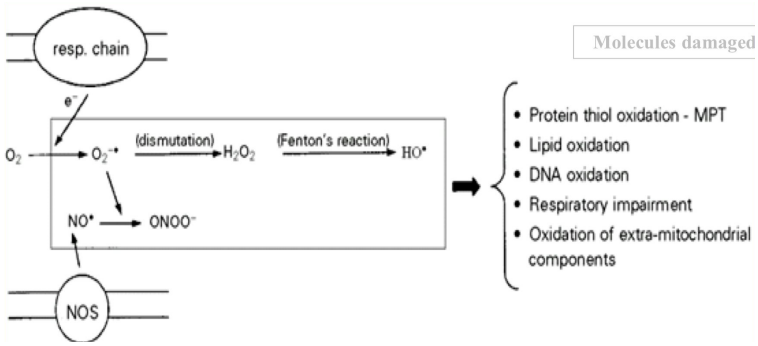
1. Active engagement with life يسوي اكتيفيتيز وعلاقاته كويسة
2. Low probability of disease or disability
3. High cognitive and physical function capacity

❖ ***Enumerate theories of aging*** ليش ما نخلد طول العمر؟ فيه نظريات كثيرة اكتشفوها العلماء:

Hypothesis	How it may work
Genetic	Aging is a genetic program activated in post- reproductive life when an individual's evolutionary mission is accomplished يعني فيه علماء قالوا إن التقدم في العمر وسبب فقدان الكثير من وظائف الجسم الطبيعية يعتبر شيء متوارث وموجود بالجينات كمصير للإنسان.
Oxidative stress	Accumulation of oxidative damage to DNA, proteins, and lipids interferes with normal function and produces a decrease in stress responses هذي النظرية ماشين عليها شركات التجميل
Mitochondrial dysfunction	A common deletion in mitochondrial DNA with age compromises function and alters cell metabolic processes and adaptability to environmental change المايتوكوندريا هي مصنع الطاقة بالخلية, مع كبر السن ممكن انه يؤثر على وظائف الخلية ويغير فيها ويساهم في عملية الـ Aging
Hormonal changes	The decline and loss of circadian rhythm in secretion of some hormones produces a functional hormone deficiency state بحيث ان بعضهم ما ينتج الا الصباح rhythm circadian بعض الهرمونات لهم وباوقات بدري (مثل الكوتريكوستيرودز) وبعضهم ما يفرز إلا بأوقات متأخرة.. فلو صارت لخبطة بهال ممكن انه يؤدي الى مشاكل بالهرمونات rhythm circadian. كثير ناس صحتهم كويسة يكون السبب انهم مرتبين نومهم طول حياتهم(طبعا احنا برا الموضوع):)..
Telomere shortening	Aging is related to a decline in the ability of cells to replicate If the cells has the ability to replicate the functional reserve occurs فلما يتأثر الريبلكيشن اللي حيفقد مارح يترجع
Defective host defenses	The failure of the immune system to respond to infectious agents and the overactivity of natural immunity create vulnerability to infection
Accumulation of senescent cells	Renewing tissues become dysfunctional through loss of ability to renew لخلايا العجوزة "اللي تشيخ" المفروض ان الشخص يتخلص منها علشان ماتكون عبء على الـ tissue اللي هي فيه بحيث انها تاخذ من طاقة الخلية وتشكل جزء منها.. هذي النظرية تقول ان الـ aging ماهو الا نتيجة ناتجة عن تراكم هالخلايا

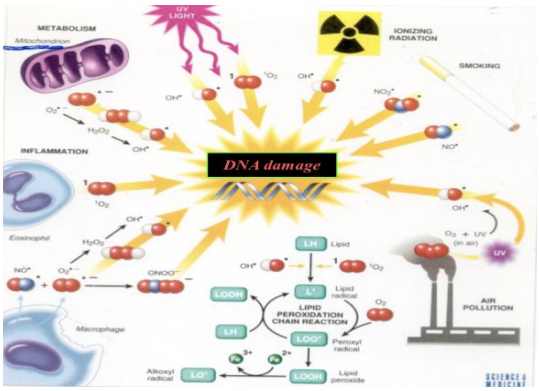
❖ Describe body changes in aging

Mitochondria produce ROS:



The respiratory chain (resp. chain) produces superoxide radicals (O2-·), which generate hydrogen peroxide (H2O2) and hydroxyl radicals (HO·). Mitochondrial nitric oxide synthase (NOS) produces nitric oxide (NO·), which combines with O2-· to generate peroxinitrite (ONOO-). All these ROS may cause mitochondrial and cellular damage if present in excess. MPT, Mitochondrial permeability transition.

OXYGEN - free radicals (FR) and reactive oxygen species (ROS)



1. Cell metabolism.
2. Environment. (Radiation)
3. Lifestyle. (Smoking)
4. Pollution.
5. Diet.
6. Infection.

Leading Causes of Death Age 65+ " Medical Diagnoses"

- Heart Disease 32%
- Cancer 22%
- Stroke 8%
- Chronic respiratory 6%
- Flu/Pneumonia 3%
- Diabetes. 3%
- Alzheimer's. 3%

Age Related Changes: Important

- Decreased height العظام بتفقد الماتيريال حقتها , lean body mass and body water الكتلة العضلية تبدا تقل وبيجي مكانها فات
- Increased body fat
- Consequence Changes in pharmacokinetics عشان كذا ننتبه لجرعة الدواء حقت كبار السن
- A lower metabolic rate يسمنون اسرع من لما كانو بشبابهم اذا استمروا على نفس نمط اكلهم اول
- Longer reaction times "response to stimuli takes more time"
- Declines in certain memory functions (especially the recent memory)
- Declines in sexual activity and in women menopause
- A functional decline in audition, olfaction, and vision
- Declines in kidney, pulmonary, and immune functions, declines in exercise performance, and multiple endocrine changes

Describe brain changes in aging

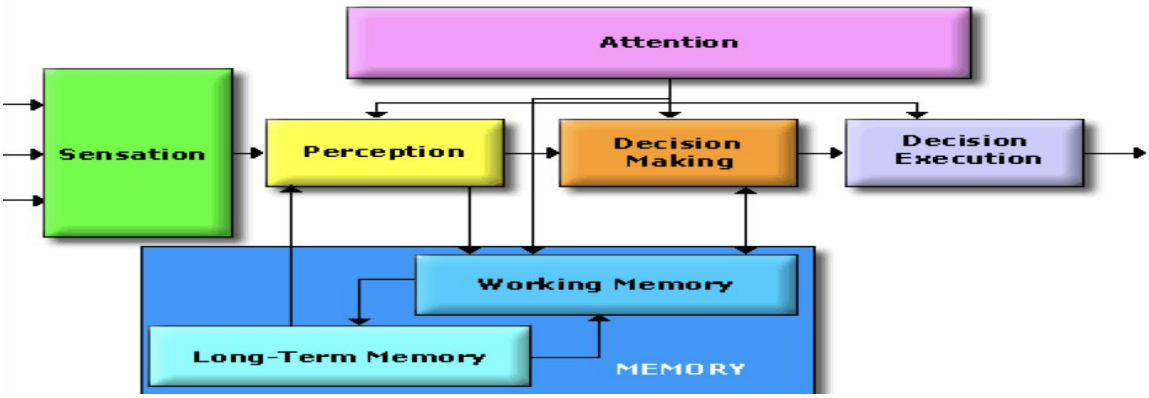
Aging nervous system

Changes	Consequences
• Decreased brain weight	• Drug toxicities
• Decreased cerebral blood flow	• delirium
• memory	• Altered mood
• Alteration in CNS neurotransmitters	• Decreased IQ scores
• Decreased vibratory sense	• "Benign senile forgetfulness"
	• Increased postural instability
	• Altered gait
	• Falls, accidents

Structure	Regional function
Basal ganglia	Becomes **bright** in appearance due to iron accumulation
Subarachnoid space	**Increase** in size due to brain shrinkage "because of the atrophy that happens to neurons the space will increase".
Hippocampus	Reduction in size due to cell loss in the structure.
Ventricles	**Increase** in size due brain shrinkage.
White matter	Reduction in size due to neuronal atrophy in the deep brain.
Cerebellum	is the youngest brain region least affected by aging

CONGITIVE CHANGES IN AGING: MENTAL PROCESSING

"Any change that occurs in any step below will cause changes in the cognitive"



DECLARATIVE MEMORY OR EXPLICIT MEMORY
EPISODIC MEMORY
(Events) SEMANTIC MEMORY
(Words, language) Late to HIPPOCAMPUS AND IS ASSOCIATED WITH CONSCIOUSNESS
SKILL MEMORY OR IMPLICIT MEMORY
IT DOES NOT INVOLVE AWARENESS. INVOLVES
CEREBELLUM,
MOTOR CORTEX,
SENSORY CORTEX,
VISUAL AREAS

Explicit memory (also called "declarative memory") is one of the two major subdivisions of long-term memory. (The other is implicit memory.) Explicit memory requires **conscious** thought—such as recalling who came to dinner last night or naming animals that live in the rainforest. It's what most people have in mind when they think of "memory," and whether theirs is good or bad. Explicit memory is often associative; your brain links memories together. For example, when you think of a word or occasion, such as an automobile, your memory can bring up a whole host of associated memories—from carburetors to your commute to a family road trip to a thousand other things.
Implicit memory is sometimes referred to as **unconscious** memory or automatic memory. Implicit memory uses past experiences to remember things without thinking about them. The performance of implicit memory is enabled by previous experiences, no matter how long ago those experiences occurred.EXTRA!!

There is decline in mental processing via reduction of attentional ability and decline in ability in forming working memory (mainly includes short term memory) There is decline in explicit memory that involves hippocampus (surroudings & Skills) and is associated with awareness & attention unlike implicit.

❖ *Describe brain changes in aging*

Nervous System changes

- Aging leads to increased cerebral amyloid
- 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)"responsible for protein and neurotransmitter synthesis" 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
- There is loss of dendritic arborization"less communication between neurons".
- Recall memory is affected more than cognitive function in normal aging بينسى اللي قلته اكثر من انه مايفهم كلامك
- Cerebral atrophy shows up on CTs and MRI scans
- Reduced Sympathetic nervous system activity هي ميزة انهم يصيرون هاديين وعندهم طولة بال بس بنفس الوقت لها ريسك فاكتور مهم هو ال bradycardia
- Reduced Neurotransmitter levels
- Changes in sleep patterns
- Abnormalities in EEG tracings لما نسوي لهم بيكون الاختلاف واضح في الاي جي بينهم وبين الاطفال والشباب
- Increased risk of stroke "because of the changes that occur in cerebral blood vessels".

Geriatric Syndromes

- Dementia (gradual) and Delirium (sudden)
- Falls
- Urinary Incontinence
- Pressure Ulcers التقرحات غالبا تحصل عندما يكون الشخص ملازم للسرير فتتكون من الضغط المستمر للمنطقة (يكون الضغط بين العظم والسرير
- Functional Decline

❖ Describe memory changes in aging

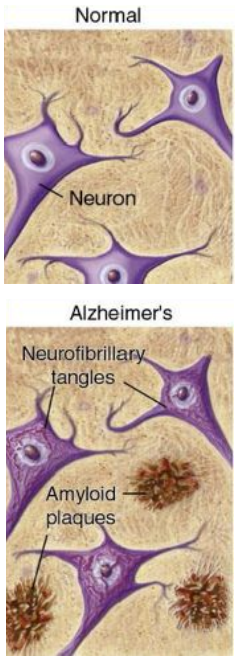
Alzheimer's Disease

- Alzheimer's disease is defined as 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. مثلا عمره ٤٠ والتغيرات اللي صارت له كانها بواحد عمره ٩٠
- Features of Alzheimer's disease:
  - an **amnesic** type of memory impairment. يبدأ ينسى (ناس, اماكن, عناوين,طرق) الخ
  - deterioration of language. ينسون بعض الكلمات وبعض اللغات ينساها يسمعها بس مايعرف معناها
  - visuospatial deficits. مثلا يطلع من البيت ولا يعرف طريق الرجوع اليه لانه نسى الاتجاهات
- Motor and sensory abnormalities, gait disturbances, and seizures are uncommon until the late phases of the disease.

غالبا الزهايمر في بداياته يؤثر على الـsensory والـbrain higher functions, اما الـmotor functions يؤثر عليهم في المراحل المتقدمة من المرض

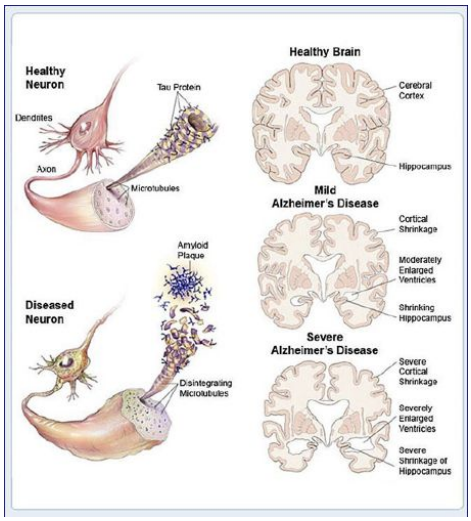
Amyloid Plaques

- **It is hallmark of Alzheimer's disease.**
- There is accumulation of amyloid plaques between nerve cells (neurons) in the brain. 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 Tangles

- 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, however, the tau protein is abnormal and the microtubule structures collapse.



AMAZING video 5 mins

❖ *Explain carotid hypersensitivity*

Baroreceptor Reflex

- Quick operation (within few seconds).if we change our posture and sudden decrease in blood pressure happen the baroreceptors quickly return it to normal
- Mediated through **autonomic reflexes.**
- Adjusts CO (cardiac output) and TPR (the peripheral resistance) to restore BP to normal.
- Influences heart and blood vessels.

  ★ Since the baroreceptors reflex are receptors and the receptors affected by aging so it will develop hypersensitivity or hyposensitivity ,, here the problem is hypersensitivity for baroreceptors reflex so, if any pressure happened to the carotid sinus they will develop fall down or severe hypotension (severe vasovagal attack).

Carotid sinus hypersensitivity

- Carotid sinus syncope occurs when there is an exaggerated vagal response to carotid sinus stimulation.
- Provoked by wearing a tight collar, looking upwards or turning the head
- Carotid sinus syndrome occurs in the elderly and mainly results in bradycardia.
- Most common etiologies of atrioventricular block.(because of severe bradycardia).
- **Do not massage both carotids simultaneously.**

لازم ننتبه لهم لما مثلا لما يحلقون او يلبسون شيء يغطي رقبتهم او لما لهم مساج اننا ما نضغط على منطقة الكاروتيد ارتري.

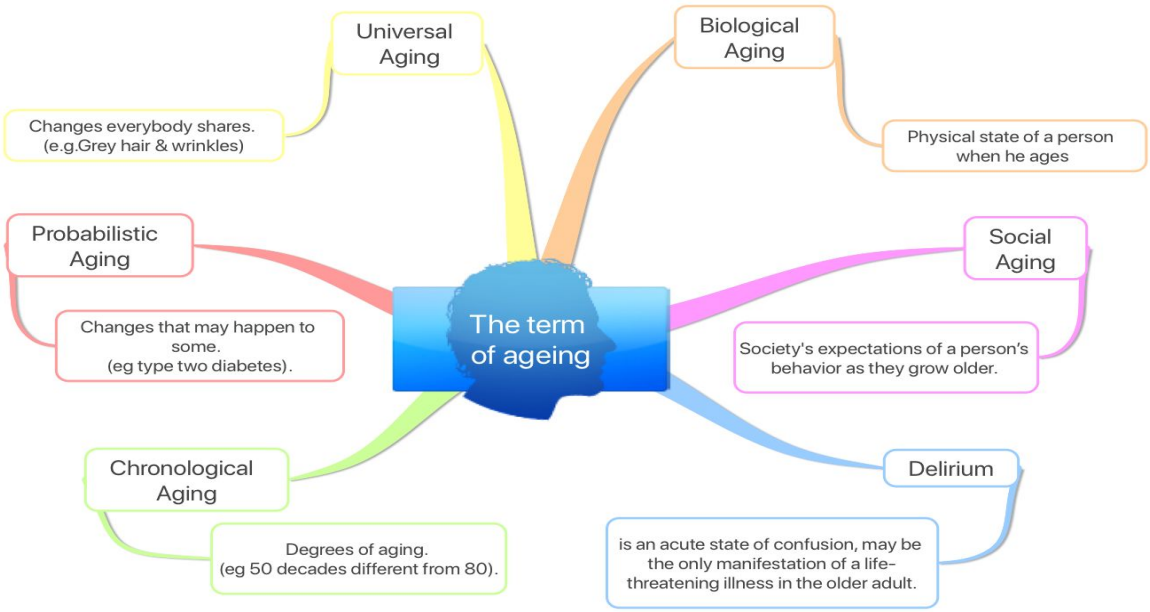
Disorders of the senses that associated with aging

Disorders Associated with Aging	Details
Vision	• Loss of ability to see items that are close up begins in the 40's (Presbyopia). • 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.
Sensorineural Hearing Loss	Damage to the hair cells of the organ of Corti may be caused by: • intense noise • viral infections • ototoxic drugs (e.g., salicylates, quinine and its synthetic analogues, aminoglycoside antibiotics, loop diuretics such as furosemide and ethacrynic acid, and cancer chemotherapeutic agents such as cisplatin) • fractures of the temporal bone • meningitis • cochlear otosclerosis • Ménière's disease • aging.
Disorders of the Sense of Taste	Disorders of the sense of taste are caused by: • transport loss • sensory loss • neural loss • Sensory gustatory losses are caused by: ○ inflammatory and degenerative diseases in the oral cavity. ○ a vast number of drugs, particularly those that interfere with cell turnover such as antithyroid and antineoplastic agents. ○ radiation therapy ○ oral ○ cavity and pharynx. ○ viral infections. ○ endocrine disorders. ○ neoplasms. ○ aging.
Pain and Sense of Touch	With age, skin is not as sensitive as in youth due to: • Loss of elasticity • Loss of pigments • Reduced fat layer Safety Implications: • Decreased ability to recognize dangerous levels of heat • Decreased ability to maintain temperature • Tendency to develop bruises, skin tears.
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 related to age. • In the Massachusetts Male Aging Study (MMAS), a community-based survey of men between the ages of 40 and 70, 52% of responders reported some degree of ED. Complete ED occurred in 10% of respondents, moderate ED occurred in 25%, and minimal ED in 17%

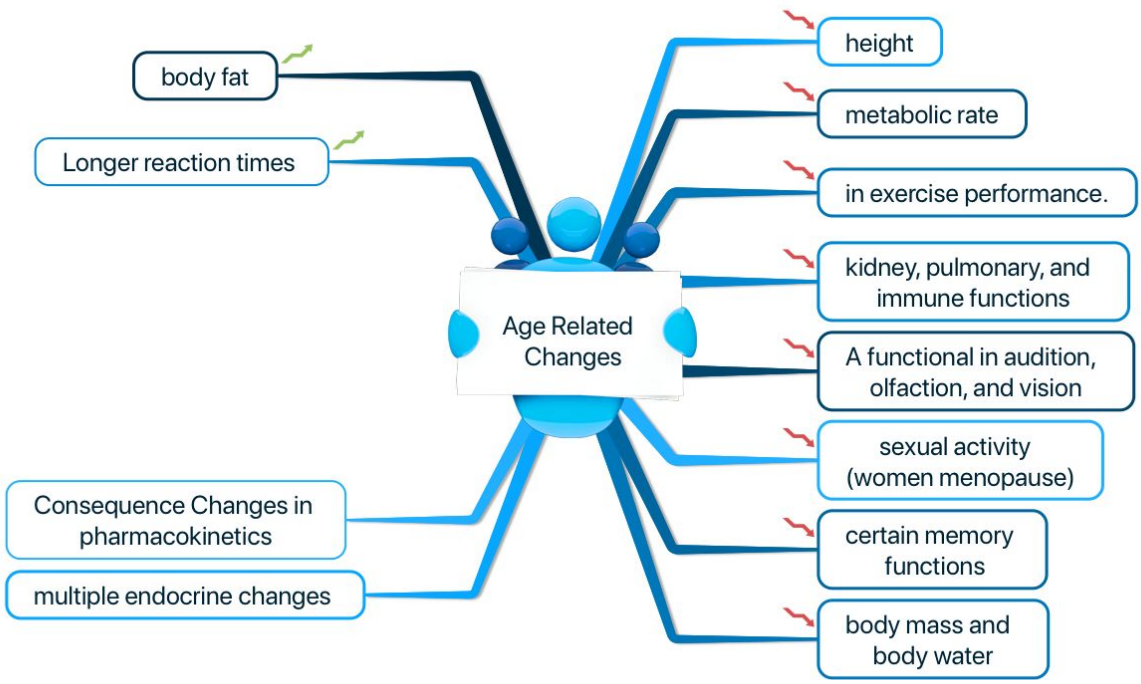
❖ Brief Geriatric Assessment Instruments

Domain	Instruments	Comments
Cognition	IQ	
Dementia	MMSE (mini-mental state examination). Qs and we evaluate the score.	Widely studied and accepted.
	Time and change (T&C) test. How much time he takes to do a specific task to move to the other one.	Sensitive and quick.
Delirium	CAM (confusion assessment method).	Sensitive and easy to apply.
Affective disorders	GDS 5-question form (Geriatric depression scale) Qs to evaluate the depression	Rapid screen.
Visual impairment	Snellen chart	Universally used.
Hearing impairment	Whispered voice	No special equipment needed.
	Pure tone audiometry	Can be performed by trained office staff.
Dental health	DENTAL	
Nutritional status	Weight loss of >4.5 kg (>10 lb) in 6 months or weight <45 kg (<100 lb) in general.	
Gait and balance	"Timed Get Up and Go" test.قد ايش ياخذ وقت عشان يوقف	Requires no special equipment.

❖ Quick review



★ **Cerebellum** is the youngest brain region least affected by aging
★ Recall memory is affected **more than** cognitive function in normal aging
★ Amyloid plaques is hallmark of Alzheimer's disease.
★ Carotid sinus syndrome occurs in the elderly and mainly results in bradycardia.



★ There is decline in mental processing via reduction of attentional ability and decline in ability in forming working memory (mainly includes short term memory) There is decline in explicit memory that involves hippocampus (surroudings & Skills) and is associated with awareness & attention unlike implicit.

❖ Questions

MCQs

1. With age, skin isn't as sensitive as in youth due to:
   A. Reduced fat layer
   B. Loss of elasticity
   C. Loss of pigment
   D. All of the above

2. Loss of the ability to see near objects begins in the …… as ……
   A. 50s, Myopia
   B. 40s, Presbyopia
   C. 30s, Presbyopia
   D. 40s, Nyctalopia

3. Delirium is a chronic state of confusion, it may be the only manifestation of a life threatening illness in older adult. .
   A. True
   B. False

4. One of the nervous system changes in old age is:
   A. Increased Sympathetic nervous system activity
   B. Decrease in the cerebral Amyloid
   C. Loss of dendritic arborization
   D. Normal EEG tracings

5. The Telomere shortening theory of aging links aging to the declined ability of cells to replicate.
   A. True
   B. False

SAQ

6. What are the safety implications regarding the pain and sense of touch in elderly people?

7. What are the main features of Alzheimer's disease?

8. The Geriatric syndrome consist of:

9. What changes occur to the Basal Ganglia with aging?

10. Name two instruments we could use to assess hearing impairment in geriatric patients.

1. D
2. B
3. B
4. C
5. A
6. 1-Decreased ability to recognize dangerous levels of heat. 2-Decreased ability to maintain temperature. 3-Tendency to develop bruises, skin tears
7. 1-Amnesic type of memory impairment.2-Deterioration of language.3-Visuospatial deficit
8. 1-Dementia and Delirium.2-Falls.3-Urinary incontinence.4-Pressure ulcers.5-Functional decline
9. Becomes bright in appearance due to iron accumulation
10. Whispered voice and pure tone audiometry