

# Alterations in Endocrine Function and Endocrine disorders in Elderly

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## Aims

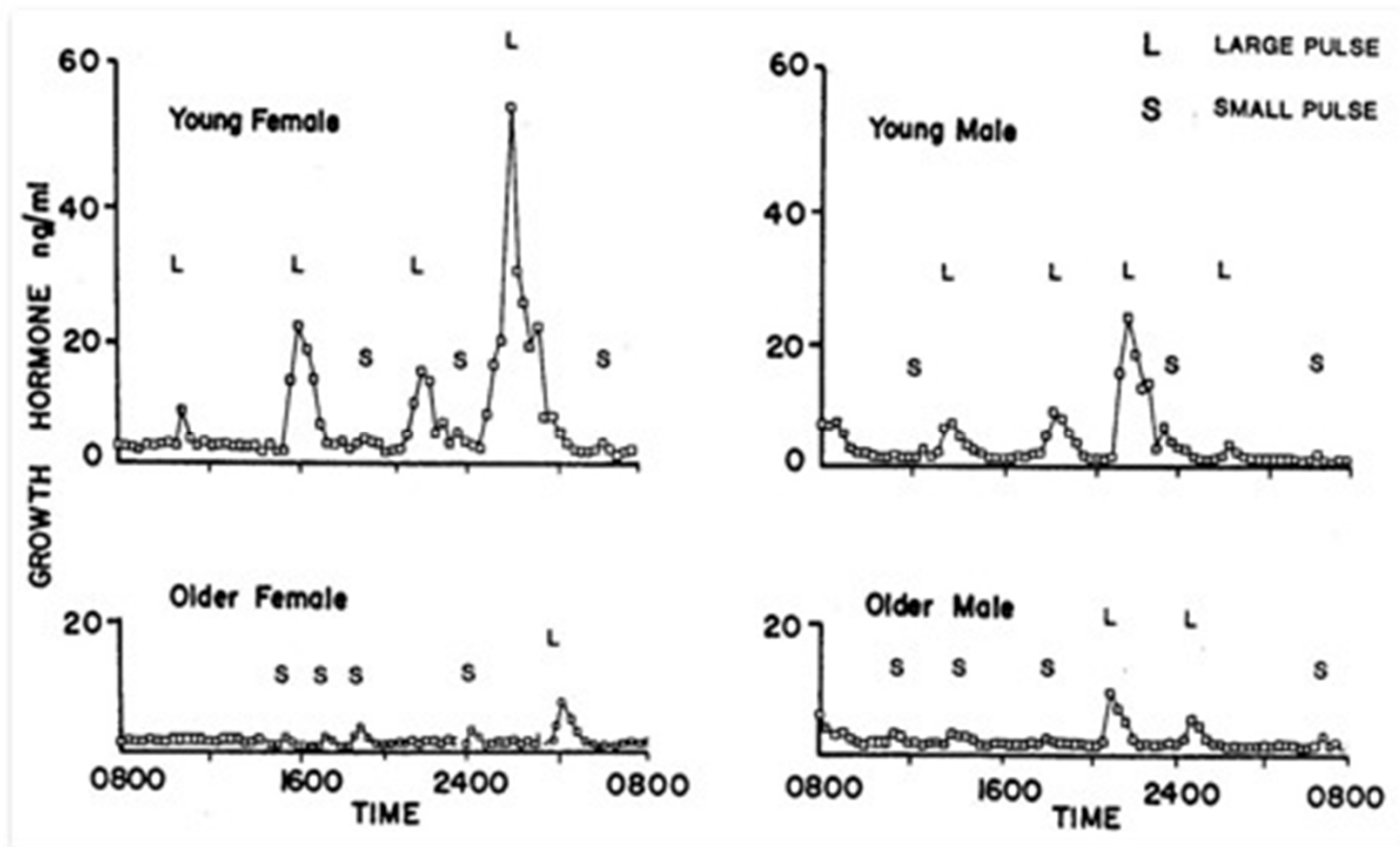
- Explain the normal age-related physiologic changes that occur in the endocrine system.
- Describe the major characteristics of common endocrine diseases in older adults: GH deficiency, hypothyroidism, hyperthyroidism, type 2 diabetes mellitus and osteoporosis.
- Apply the nursing process in caring for an older adult with an endocrine disorder.

# Age-related physiologic changes in the endocrine system

- The secretion of hormones **decreases** within most axes.
  - A **reduction in the sensitivity** of tissues to their action.
  - Normal **circadian rhythms** are lost.
- Hypothalamus reduced its function to maintain homeostasis.

# Pituitary: GH, IGF and Prolactin

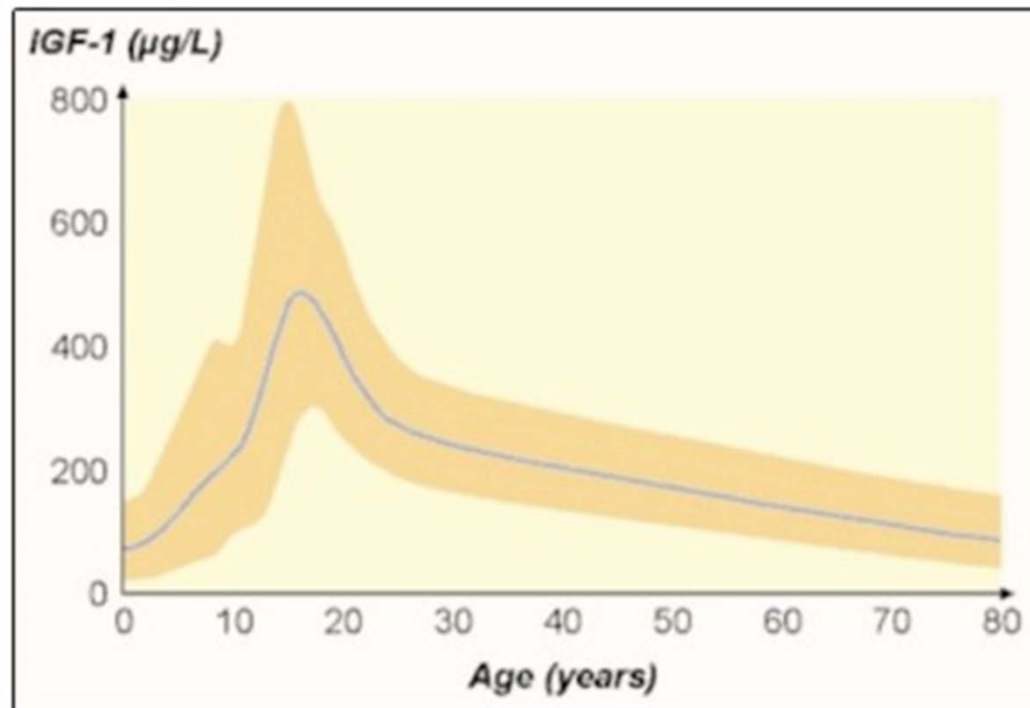
- Levels of both **GH** and **IGF-I** fall in concert during ageing (~ 50 percent of young-age)



Garcia JM, et al [Updated 2019 Oct 7].  
<https://www.ncbi.nlm.nih.gov/books/NBK279163/>

# Pituitary: GH, IGF and Prolactin

- the GH/IGF-I axis represents the principal anabolic hormone.



# Features of Adult Growth Hormone Deficiency

Increased fat mass especially abdominal fat

Decreased lean body mass

Decreased muscle strength

Decreased cardiac capacity

Decreased exercise performance

Decreased bone mass (Osteoporosis)

Decreased RBC volume

Atherogenic lipid profile

Thin dry skin

Impaired sweating

Poor venous access

# Features of Adult Growth Hormone Deficiency

Psychosocial problems- ➤ low self-esteem

➤ depression

➤ anxiety

➤ fatigue and listlessness

➤ sleep disturbances

➤ emotional lability and poor self-control

➤ social isolation

➤ poor marital and social-economic performance

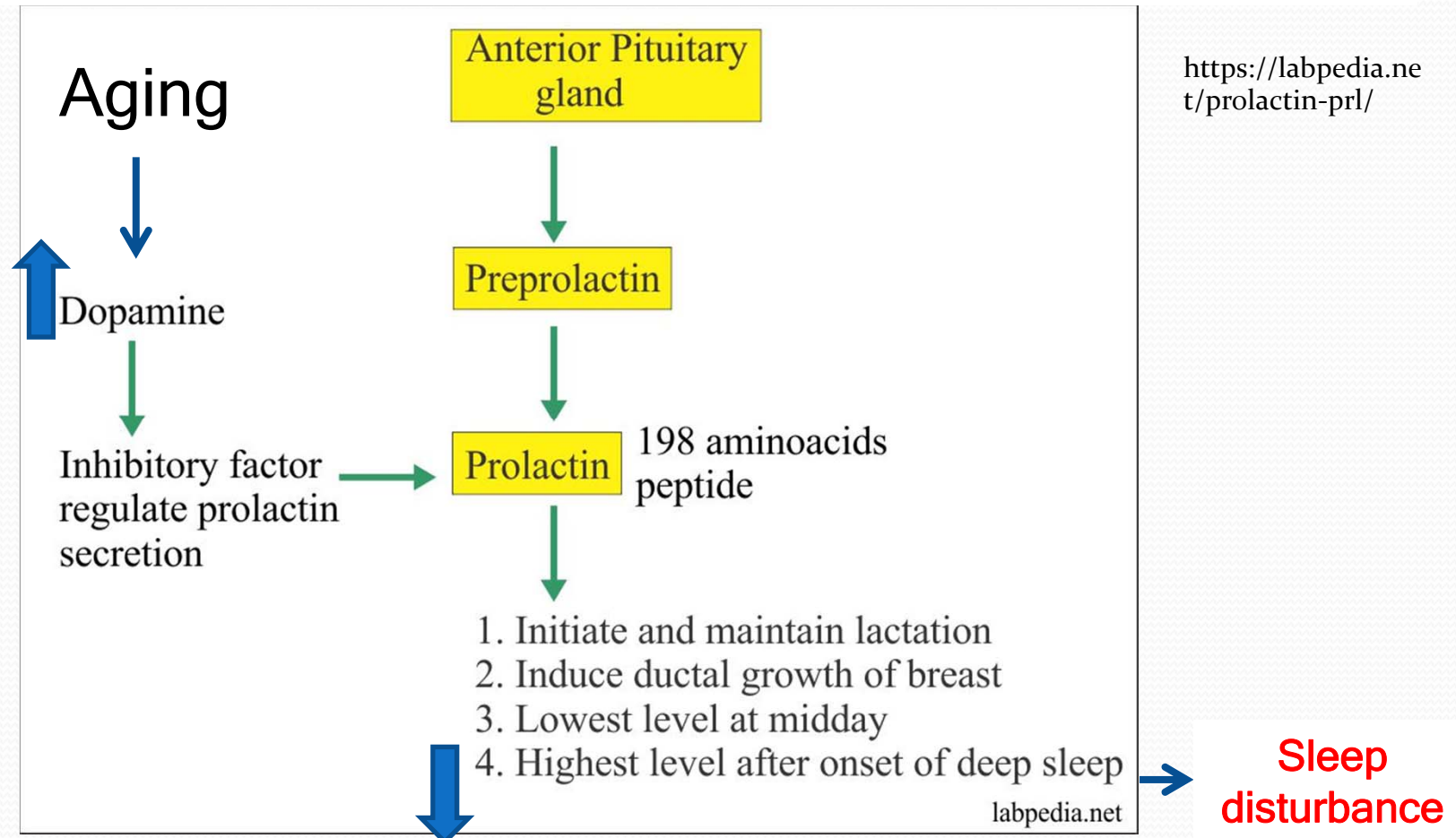
➤ The decline in GH may also play a role in cognitive changes observed with aging.

- **vocabulary** and **long-term memory**
- **short term memory** and **active problem-solving**

o Regular exercise has been shown to increase lean body mass, muscle strength, and aerobic capacity in older men.

GH use for anti-aging purposes is currently **prohibited** by US federal law

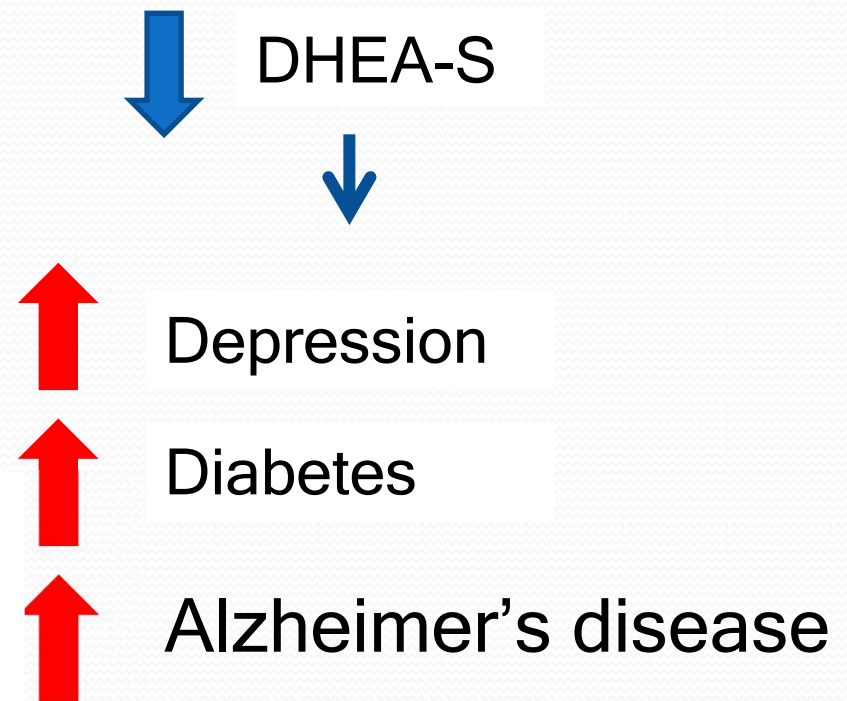
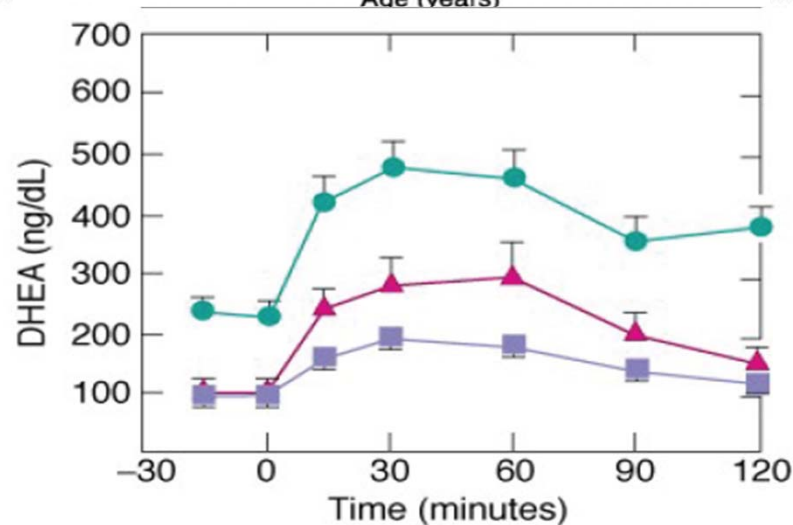
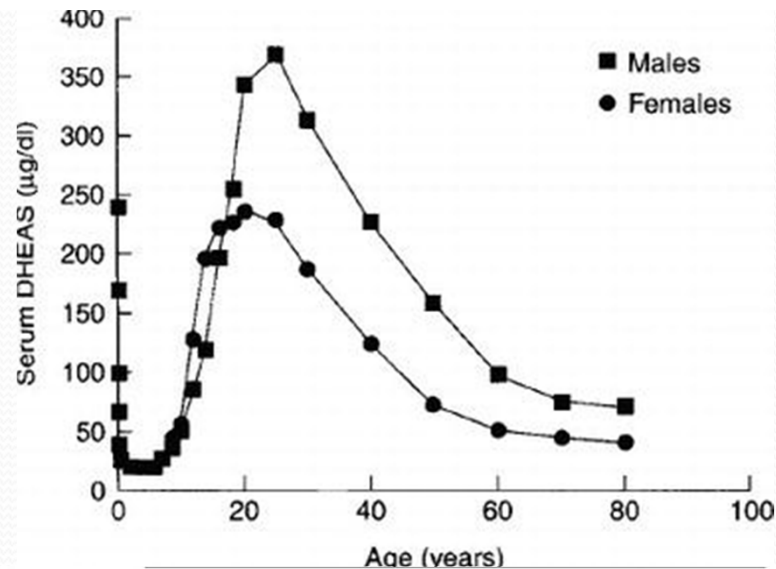
- Peak concentrations of PRL, which occur prior to the onset of sleep, is **negatively correlate with age.**



**Dopaminergic agents such as metoclopramide, might help age-related disordered sleep patterns.**

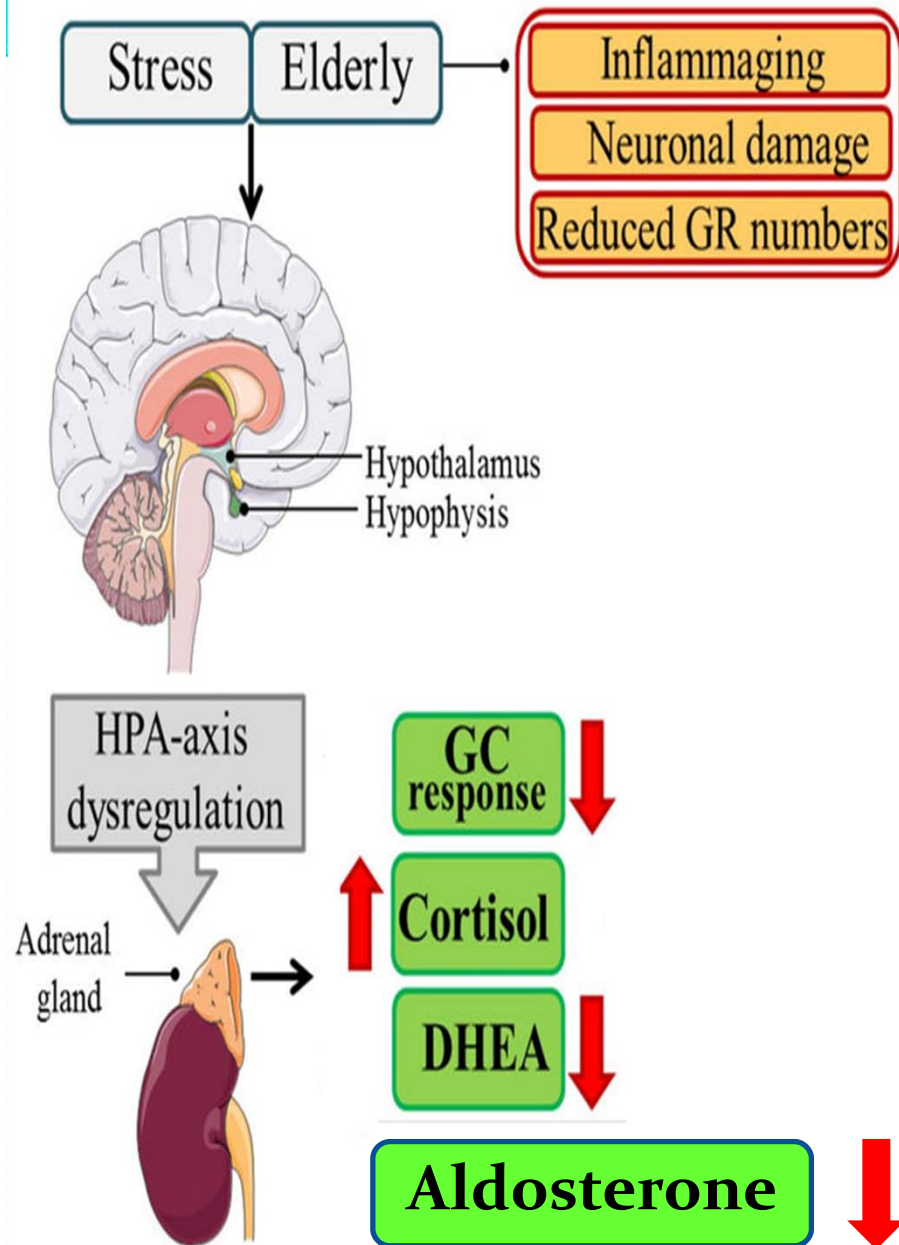
# The Hypothalamic-Pituitary-Adrenal Axis

- Level of DHEA-S is negatively correlate with age.



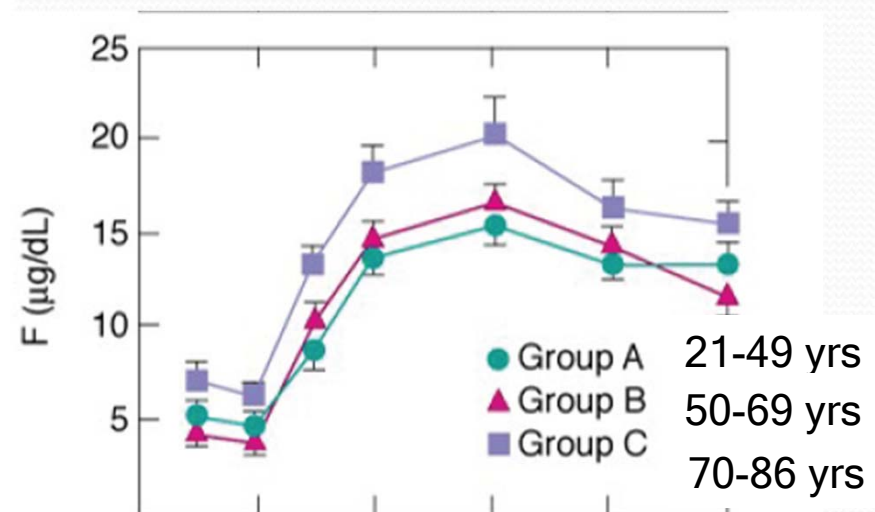
- Group A 21-49 yrs
- ▲ Group B 50-69 yrs
- Group C 70-86 yrs

# The Hypothalamic-Pituitary-Adrenal Axis



Unlike many other hormones, concentrations of both cortisol and its binding globulin remain relatively consistent throughout aging

Similarly to other hormone aldosterone moderate reduced with aging.



# The Hypothalamic-Pituitary-Adrenal Axis

- It is not known if these elevated cortisol levels contribute to the increased hypertension, glucose intolerance, muscle atrophy, and impaired immune function observed in the elderly.
- However, an elevated urinary free cortisol level is an independent predictor of osteoporotic fractures in the elderly.

## Adrenal Hypersecretion

- Adrenal hypersecretion (Cushing syndrome) is uncommon in the elderly
- Adrenal hypersecretion mimics normal aging processes

## Adrenal Insufficiency

- Adrenal insufficiency are common complaints in adrenally intact elderly patients; the most specific sign of adrenal insufficiency **in the elderly is hyperpigmentation**

# Adrenal Insufficiency

- Hyperkalemia
- Metabolic acidosis
- Hypoglycemia

- Hypotension
- Hyponatremia
- dehydration

## Treatment

- The metabolic clearance rate of cortisol decreases with age, older patients generally require lower replacement doses of cortisol.
- Doses of hydrocortisone (200 mg/d IV in four divided doses) should be weaned as soon as possible.

# The Hypothalamic-Pituitary-Thyroid Axis

Elderly can developed

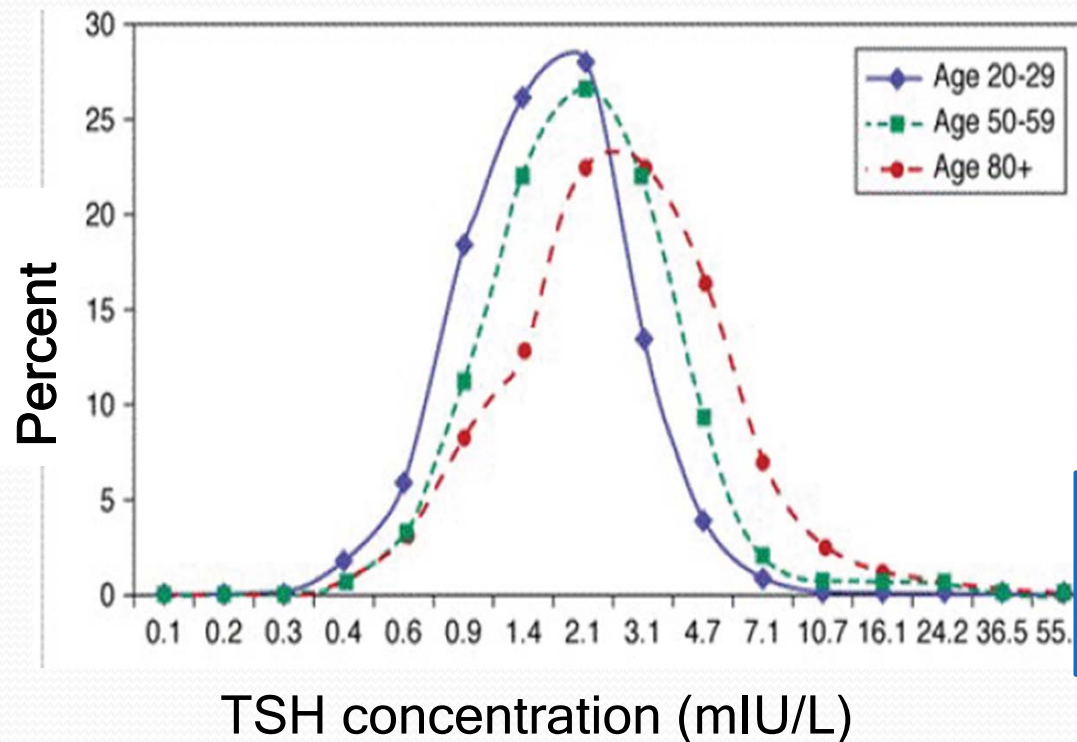
- Hypothyroidism
- Subclinical Hypothyroidism
- Hyperthyroidism
  - o Graves disease (80%)
  - o toxic nodular hyperthyroidism (15%)
- Subclinical Hyperthyroidism

# The Hypothalamic-Pituitary-Thyroid Axis

- Changes in thyroid function tests occur in the physiology of aging.
- TFT is composed of TSH, thyroid hormone and thyroid antibodies.

# TSH

- The increase in TSH with age was confirmed in large longitudinal population studies. (Bremner A. et al., 2012, J Clin Endocrinol Metab)



✓ Age < 50 year upper normal limit TSH 3.5 (mIU/L)

✓ Age > 80 year upper normal limit TSH 7.5 (mIU/L)

✓ upper limit TSH 7.0 (mIU/L) cover over 97.5 percentile

- Age-specific TSH range would prevent misdiagnosis of subclinical hypothyroidism in elderly.

# Thyroid hormone



T4 synthesis



T4 degradation

- Serum T4 is unaffected during aging.



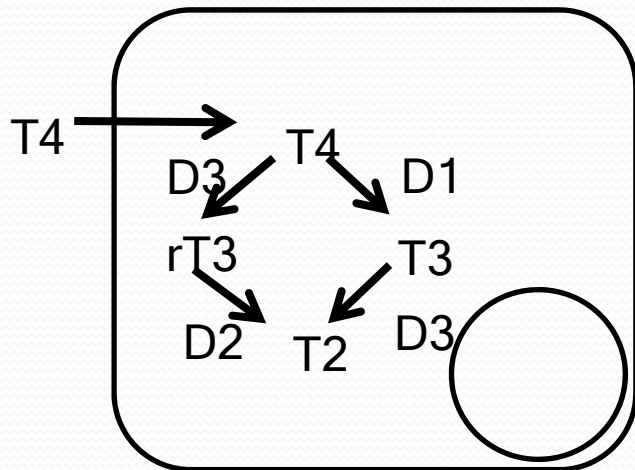
T3 synthesis



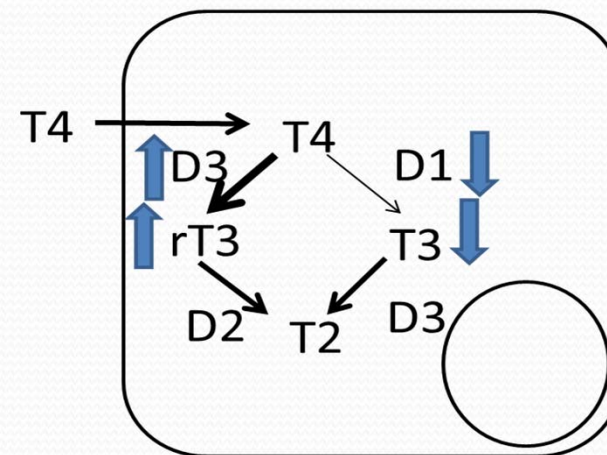
T3 degradation

- Serum T3 is decreased during aging.
- Serum rT3 is normal or increased during aging.

Young age



Old age



# Prevalence of Thyroid diseases

- Hypothyroidism incidence is **2-7 percent in people over 60** year-old,
- Hypothyroidism is **5 to 8 times more common in women** than men.
- Hypothyroidism has a higher prevalence in iodine-sufficient regions than in areas of mild iodine deficiency.
- The risk of developing overt hypothyroidism increases with age in the presence of anti thyroid Abs or elevated TSH antibody.

# Prevalence of Thyroid diseases

- It is important to realize that elderly patients with hypothyroidism may lack the classical symptoms of hypothyroidism.
- Most patients with subclinical hypothyroidism have a mildly elevated TSH level (above the reference range, but below 10 mU/L).
- The frequency of subclinical hypothyroidism varies from 6% to 13% in different populations.
- Subclinical hypothyroidism is more common in women than men.

# Hypothyroidism and cardiovascular risk

- A greater prevalence and severity of coronary atherosclerosis in the hypothyroid patients as compared to controls.
- Subclinical hypothyroidism (SCH) is associated with increased risk of cardiovascular disease or heart failure in those with serum TSH  $> 10\text{mIU/litre}$ .
- Treatment of SCH with levothyroxine was associated with fewer IHD events. in younger individuals (40-70 years), but this was not evident in older people ( $>70$  years)

# Hypothyroidism and cognitive function

- Overt hypothyroidism is associated with cognitive impairment and depression.
- The association between subclinical hypothyroidism and cognitive impairment is still controversy.
- There is a relationship between thyroid function in euthyroid elderly people and cognition function.
- Higher TSH concentration and lower free thyroxine levels was associated with lowest mortality rate.

# Hypothyroidism and longevity

- Low thyroid function may lead to low metabolic rate which in turn could cause calorie restriction. Calorie restriction is associated with improved survival.
- Offspring from these subjects with reported familial longevity also had lower serum FT4 and T3 and a trend for higher TSH levels, supporting the hypothesis that TH and longevity are genetically related.
- The role of TSH receptor and longevity is still unclear.

# Aging thyroid gland

- Changes in thyroid function tests occur in the physiology of aging.
- It is important to realize that elderly patients with hypothyroidism may lack the classical symptoms of hypothyroidism.
- Higher TSH concentration and lower free thyroxine levels was associated with longevity.

# Treatment

- Elderly patients should be started on approximately 25 to 50  $\mu\text{g}$  of levothyroxine
- the dose should be increased by approximately 25  $\mu\text{g}$  every **4 to 6 weeks** until the serum TSH comes into the normal range.
- Patients with cardiovascular disease, even lower initial doses can be used (12.5  $\mu\text{g}$ ) and increased at a slower rate.
- subclinical hypothyroidism require **follow-up**

# Prevalence of hyperthyroidism

- Toxic nodular hyperthyroidism to be the underlying aetiology in 28-65% of individuals aged >60 years compared with 5-10% of people aged <40 years.
- Subclinical Hyperthyroidism
  - o Exogenous cause: excess dose of levothyroxine
  - o Endogenous cause: similar to overt hyperthyroidism
- The lower the serum TSH concentration, the higher the risk of clinically significant consequences.

# Hyperthyroidism consequences

## CNS

- increased risk of dementia, though findings remain conflicting
- increased risk of cerebrovascular disease.

## CVS

### Atrial fibrillation

- In patients aged  $\geq 60$  years with subclinical hyperthyroidism, the frequency of atrial fibrillation is also increased.

## Musculoskeletal

- reduced bone mineral density, particularly in post-menopausal women

# Treatment

- Beta-blocking agents are useful in alleviating symptoms

## Anti-thyroid drugs

- ✓ PTU (propylthiouracil) prototype

- ✓ Tapazole (methimazole)

- Radioactive iodine is the therapy of choice in elderly patients

- After treatment for 6-12 weeks, patients become euthyroid

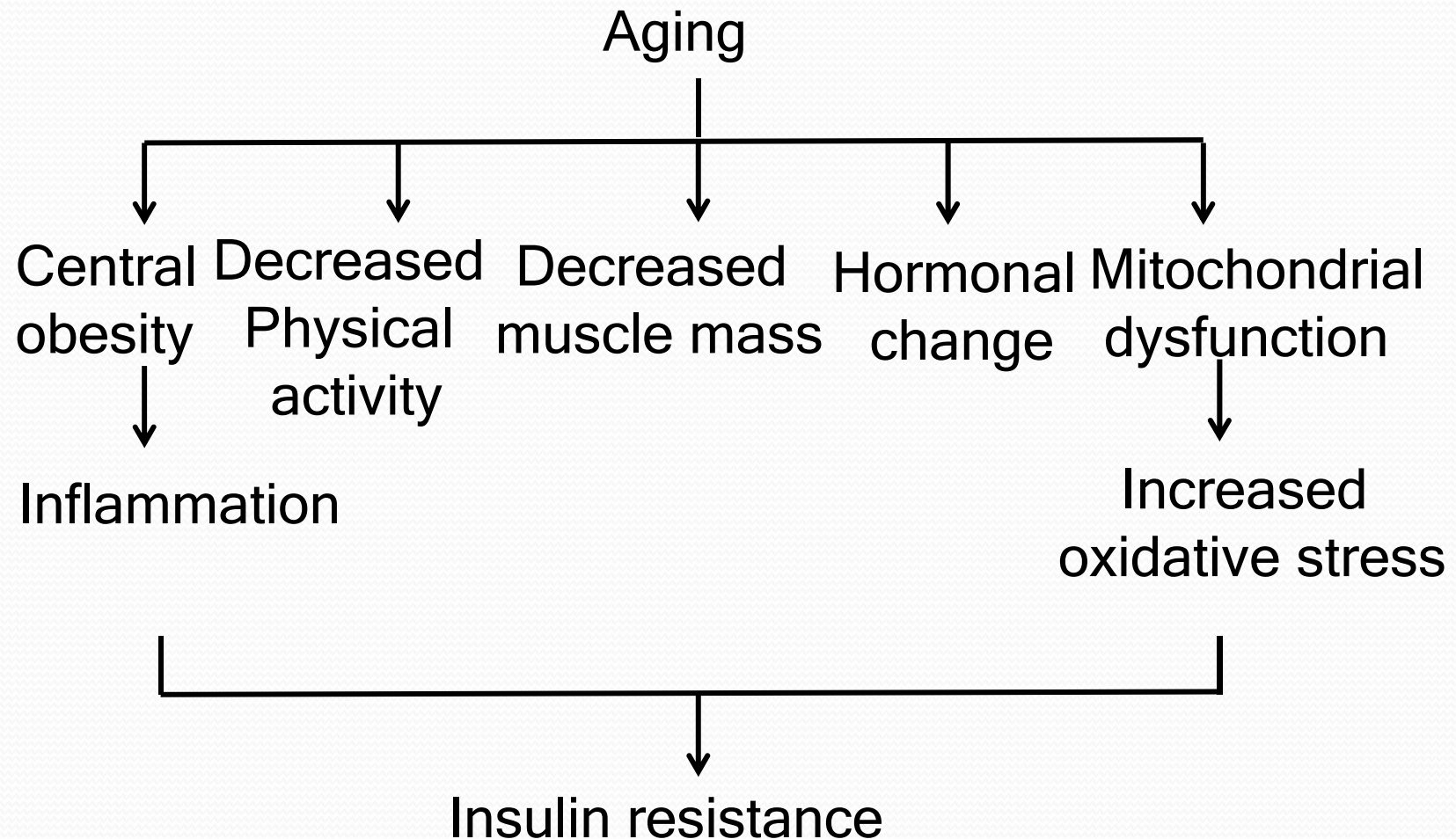
- Need follow up, 80 percent or more adequate treatment will develop hypothyroidism.

- subclinical hyperthyroidism require follow-up

# Pancreatic Hormones

- Insulin secretion is known to be affected by ageing, falling with advancing age by as much as 0.5% per year, independent of its action in peripheral tissues.
- Aging is an important risk factor for metabolic disorders, including obesity, impaired glucose tolerance, and type 2 diabetes (T2D).
- The prevalence of T2D increases with age and peaks at 60-74.

# Aging and insulin secretion



# Aging and Diabetes

- The pathogenesis of T2D in aging is peripheral insulin resistance and impaired insulin secretion from  $\beta$ -cells.
- An increased incidence of diabetes is observed with age.
- Insulin resistance is increased with age.
- Pancreatic  $\beta$ -cell mass decreased with age due to reduction of  $\beta$ -cell proliferation and increased  $\beta$ -cell apoptosis.

# Aging and Diabetes

- Aging people should exercise to prevent obesity and increased muscle mass, which reduced insulin resistance.
- Aging people should take healthy food to prevent over nutrient which increased  $\beta$ -cell apoptosis.

# Treatment

- Similar to Type 2 diabetes in adult.
- Current guidelines suggest glycemic targets of **140 to 180 mg/dL** in both critically ill and non-critically ill-hospitalized patients.
- Less stringent glycemic targets may be appropriate for patients who have multiple comorbidities.
- in general, glucose levels should be maintained at values **below 200 mg/dL**.

# Osteoporosis

- Twenty-five percent of women have vertebral fractures by age 70; by age 80, the figure is closer to 50%.
- More than 90% of hip fractures occur in patients over age 70, and by age 90.
- Hip fractures are associated with significant morbidity, and an up to 20% increase in mortality rates.
- By age 70, approximately 80% of women have a hip BMD that is osteopenic or osteoporotic, compared with 40% of women in their fifties.

# Definition and Risk of Fracture

- Osteoporosis is defined as a BMD T-score of  $-2.5$  standard deviations below the young adult mean value.

| Diagnosis                  | Criteria (WHO)                                                                                                                                                                                            |
|----------------------------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Normal                     | Bone mineral density or content $-1$ SD and above of the young adult mean value (T-score at $-1.0$ and above)                                                                                             |
| Osteopenia (low bone mass) | Bone mineral density or content between $-1$ SD and $-2.5$ SD of the young adult mean value (T-score between $-1$ and $-2.5$ ; includes individuals in whom prevention of bone loss would be most useful) |
| Osteoporosis               | Bone mineral density or content at or below $-2.5$ SD of the young adult mean value (T-score at or below $-2.5$ )                                                                                         |

Modified and reproduced, with permission, from Kanis JA: The diagnosis of osteoporosis. J Bone Miner Res. 1994;9:1137.

# Vitamin D

- Vitamin D deficiency is common in the elderly.
- Vitamin D metabolism changes with age.
  - decreased sun exposure
  - an impaired ability to form vitamin D precursors in the skin
  - a decreased dietary intake of vitamin D
  - (possibly) an age-related decline in vitamin D receptors in the duodenum
  - the ability to convert vitamin D to its active moiety (1,25[OH]<sub>2</sub>-D<sub>3</sub>) is impaired with age.

# Treatment

- The current recommendation from the National Osteoporosis Foundation is 800 to 1000 IU/d.
- 700 to 800 IU/d of vitamin D reduced the risk of hip and nonvertebral fractures in elderly patients.
- Exercise reduced the rate of falls and risk of falling, as did TaiChi. Walking—generally 30 minutes three times a week—is often suggested for frail individuals.
- Bisphosphonates are the mainstay of therapy in the elderly..

# Bisphosphonates

- the oral medications are available as a **daily, weekly** (**alendronate, risedronate**), and once **monthly** (**risedronate, ibandronate**) medication and the **IV therapies** can be given every 3 or 12 months (**ibandronate and zoledronic acid** respectively).
- **Side effects** are nausea, heartburn, epigastric distress, arthromyalgias and myalgias (IV and oral bisphosphonates).
- **Osteonecrosis of the jaw** is a **rare** event in patients using these agents at a dose for osteoporosis.

