



# **Common Thyroid & calcium Disorders in Children**

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**Consultant**

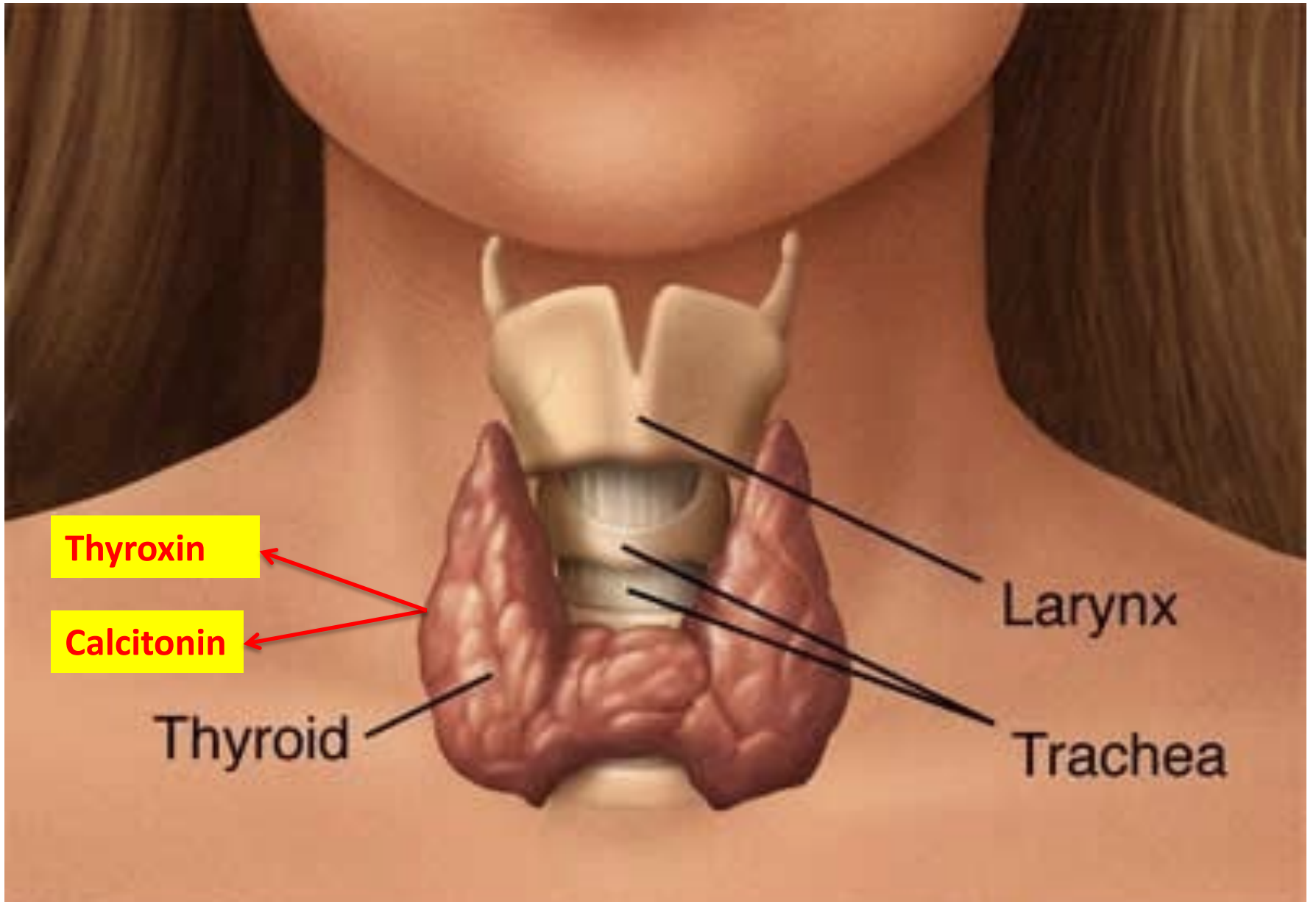
**Assistant professor**

**Pediatric Endocrinology**

**King Saud University**

# Objectives

- Thyroid Anatomy and physiology
- Hypothyroidism
- Hyperthyroidism
- Rickets



Thyroxin

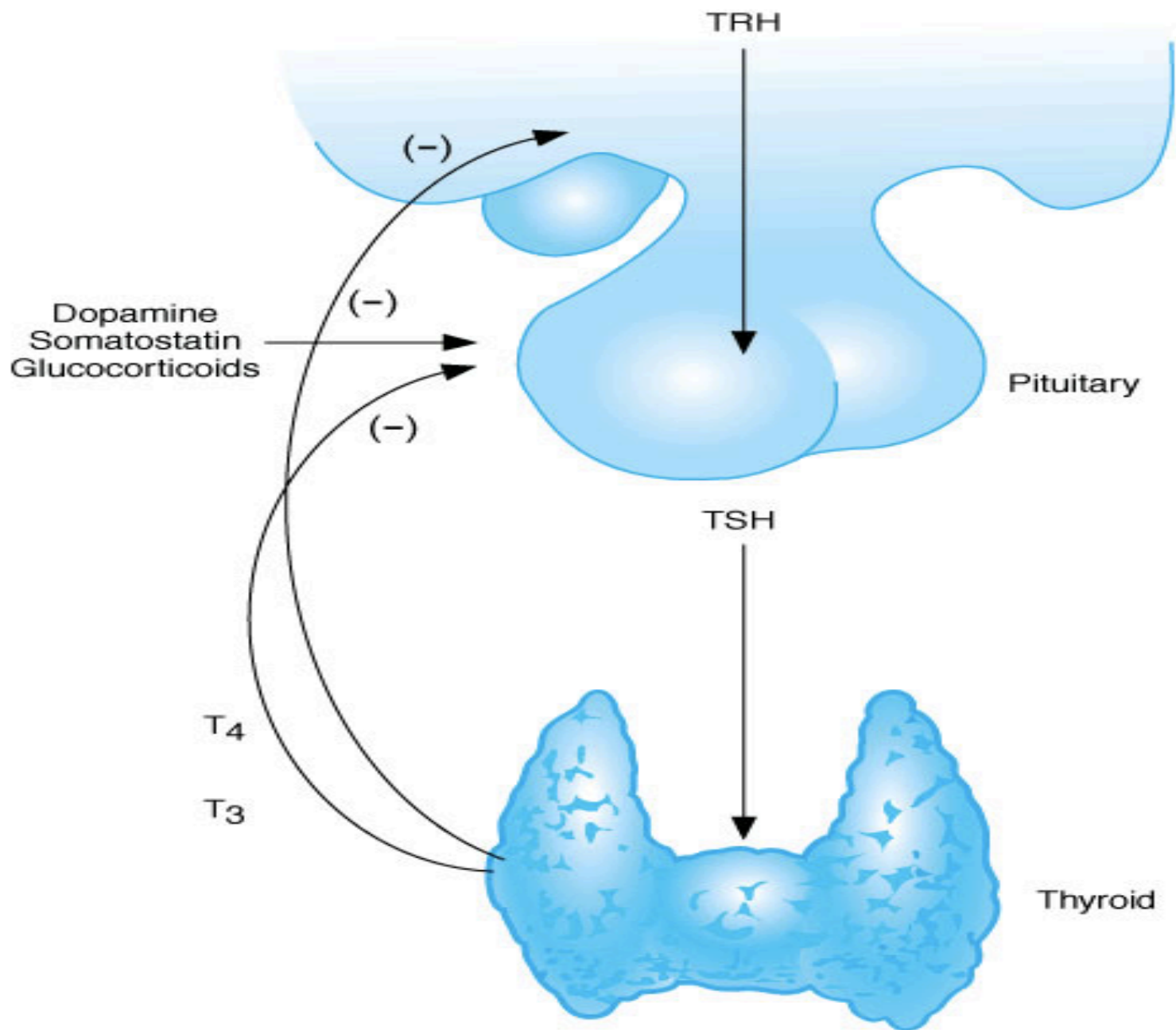
Calcitonin

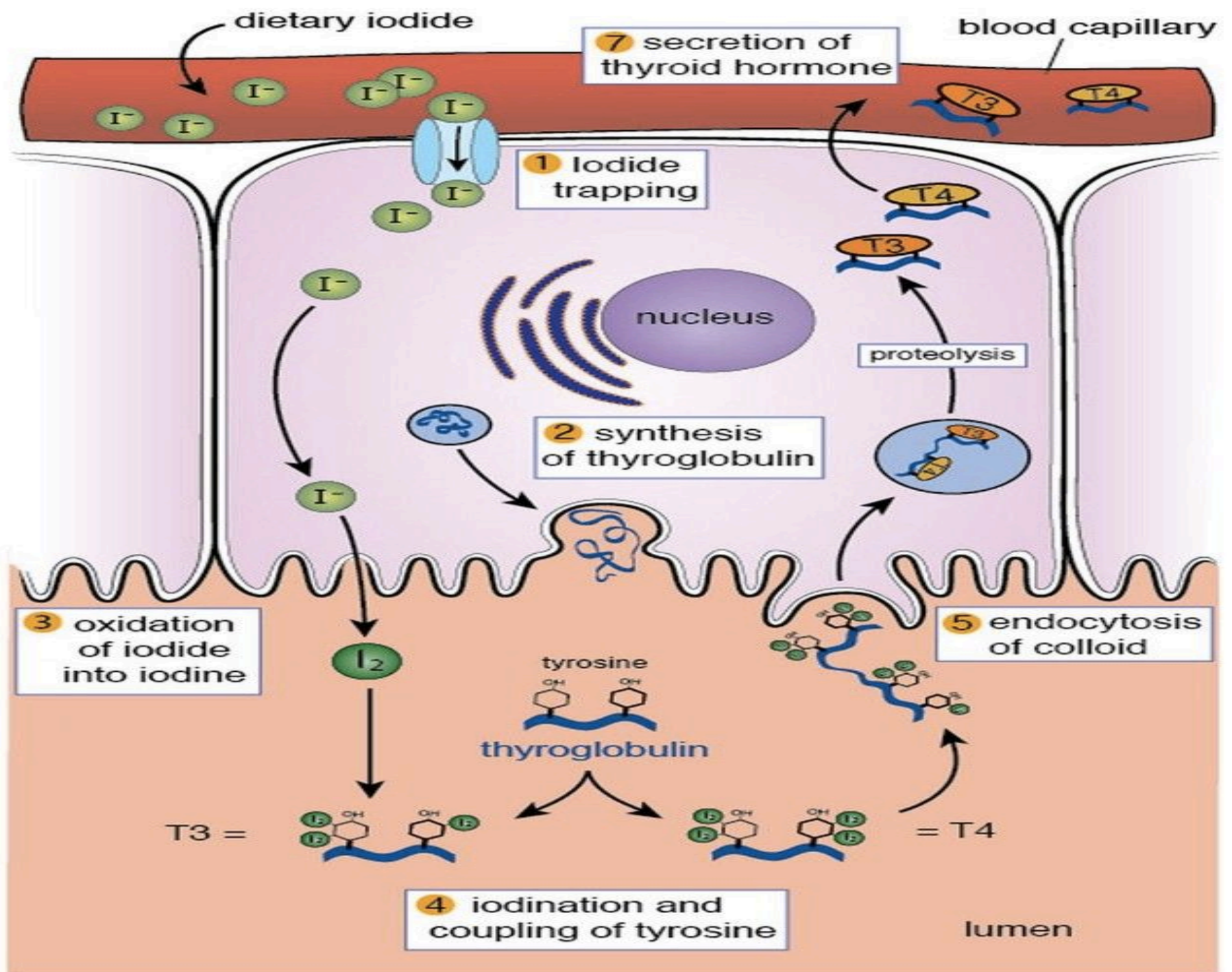
Thyroid

Larynx

Trachea

# Hypothalamus





# Thyroid Function: blood tests

TSH	0.4 – 5.0 mU/L
Free T4 (thyroxine)	9.1 – 23.8 pmol/l
Free T3 (triiodothyronine)	2.23-5.3 pmol/l

	<u>T4</u>	<u>T3</u>
<b>Potency</b>	1	10
<b>Protein Bound</b>	10-20	1
<b>Half-Life</b>	5-7d	< 24h
<b>Secreted by thyroid</b>	100 ug/d	6 ug/d

# Effects of thyroid hormones

- Linear growth & pubertal development
- Normal brain development & function
- Calcium mobilization from bone
- Increase in basal metabolic rate
- Inotropic & chronotropic effects on heart
- Stimulates gut motility
- Increase in serum glucose, decrease in serum cholesterol
- Play role in thermal regulation



In  
pediatrics





# HYPOTHYROIDISM

# Causes of hypothyroidism

## Primary

- Congenital
- Autoimmune (Hashimoto)
- Iodine deficiency
- Subacute thyroiditis
- Drugs (amiodarone)
- Irradiation
- Thyroid surgery

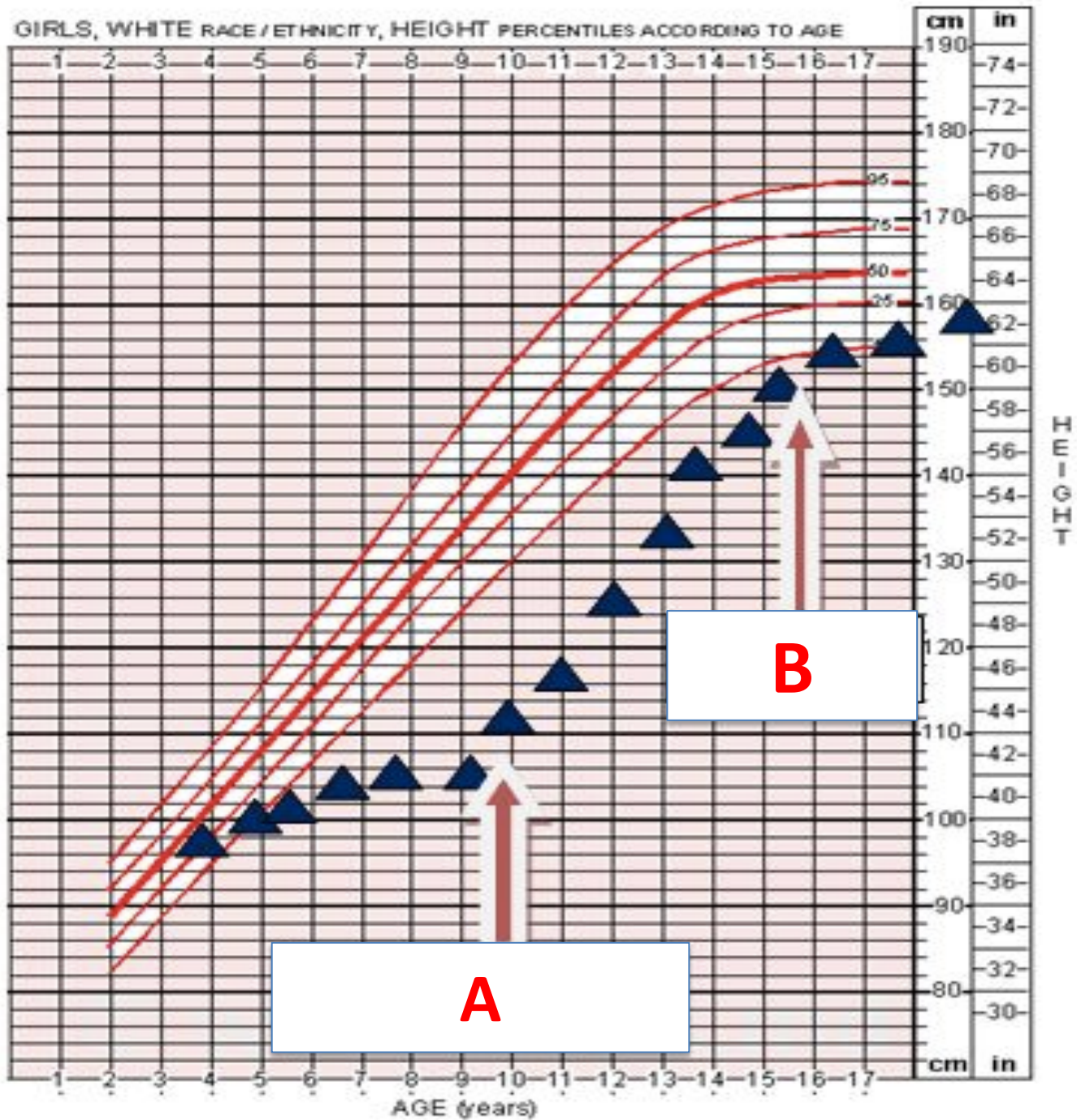
## Secondary

- TSH deficiency
- TRH deficiency

# Clinical features

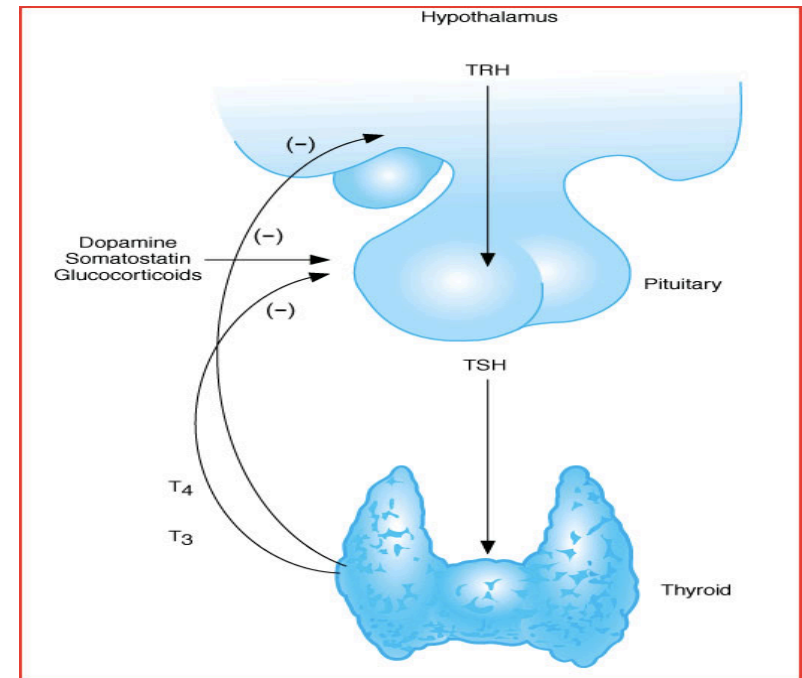
- Poor growth ..... Stop growing
- Delayed bone age
- Poor school performance
- Delayed puberty
- Weight gain
- Fatigue
- Constipation
- Goiter
- Dry skin
- Cold Intolerance
- Sinus Bradycardia
- Delayed reflexes

GIRLS, WHITE RACE / ETHNICITY, HEIGHT PERCENTILES ACCORDING TO AGE



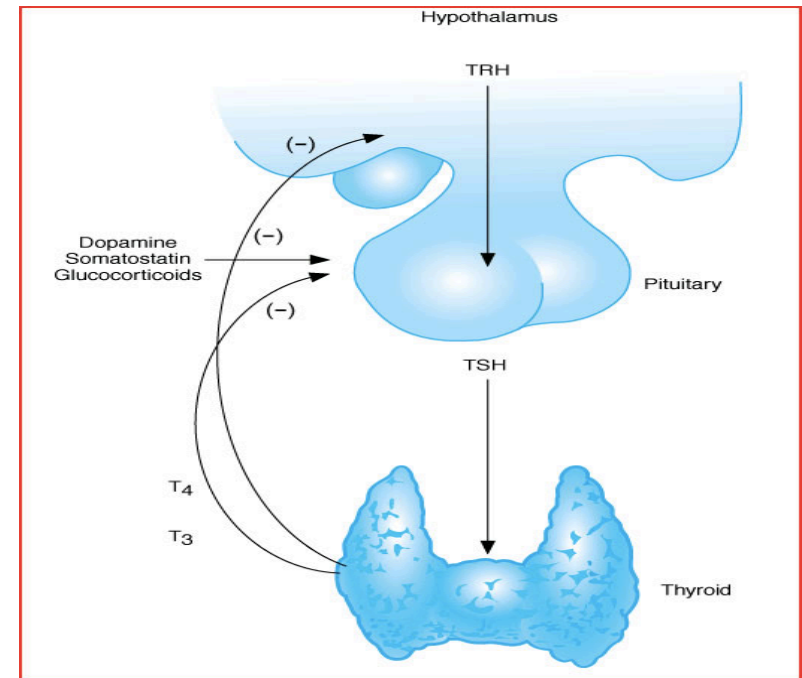
# Primary Hypothyroidism

- Decreased thyroid hormone levels
  - ↓↓T4
  - Possibly ↓ T3
  - ↑TSH



# Secondary Hypothyroidism

- Decreased thyroid hormone levels
  - ↓↓ T4
  - ↓ T3
  - ↓ TSH



# Hashimoto's thyroiditis

- Most common cause of hypothyroidism
- Autoimmune lymphocytic thyroiditis
- Antithyroid antibodies:
  - Thyroglobulin Ab
  - Microsomal Ab
  - TSH-R Ab (block)
- Females > Males
- Runs in Families!

# Congenital Hypothyroidism

- 1 in 3000-4000 neonate
- The most common cause of treatable and preventable mental retardation..... The earlier dx the better IQ
- Congenital Anomalies increased by 10%(cardiac)
- In more than 90% of the cases it is permanent



# Impact on IQ when diagnosis is delayed

<b>Age of Diagnosis</b>	<b>% with IQ &gt; 85</b>
<b>3 months</b>	<b>78%</b>
<b>6 months</b>	<b>19%</b>
<b>&gt; 7 months</b>	<b>0%</b>

# Congenital Hypothyroidism: Causes

- Agenesis
- Dysgenesis
- Dyshormonogenesis
- Ectopic gland
- Iodine deficiency
- Maternal anti-thyroid medication

## Clinical Features of Congenital Hypothyroidism

Finding	%
<b>Lethargy</b>	<b>96%</b>
<b>Constipation</b>	<b>92%</b>
<b>Feeding problems</b>	<b>83%</b>
Respiratory problems	76%
Dry skin	76%
Thick tongue	67%
Hoarse cry	67%
Umbilical hernia	67%
Prolonged jaundice	12%
Goiter	8%



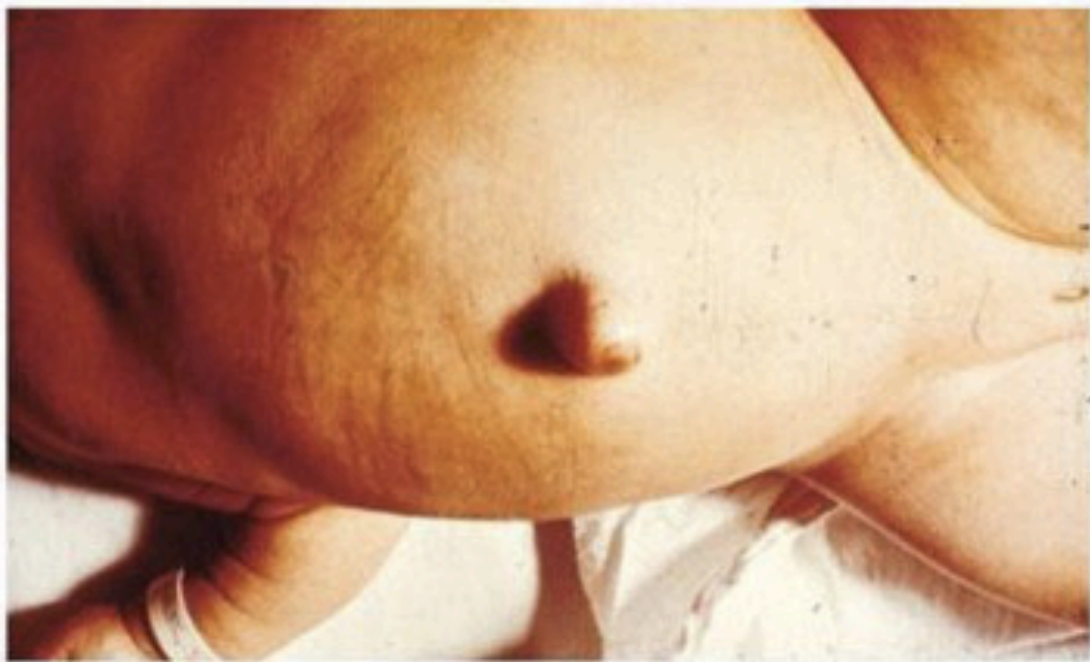




A

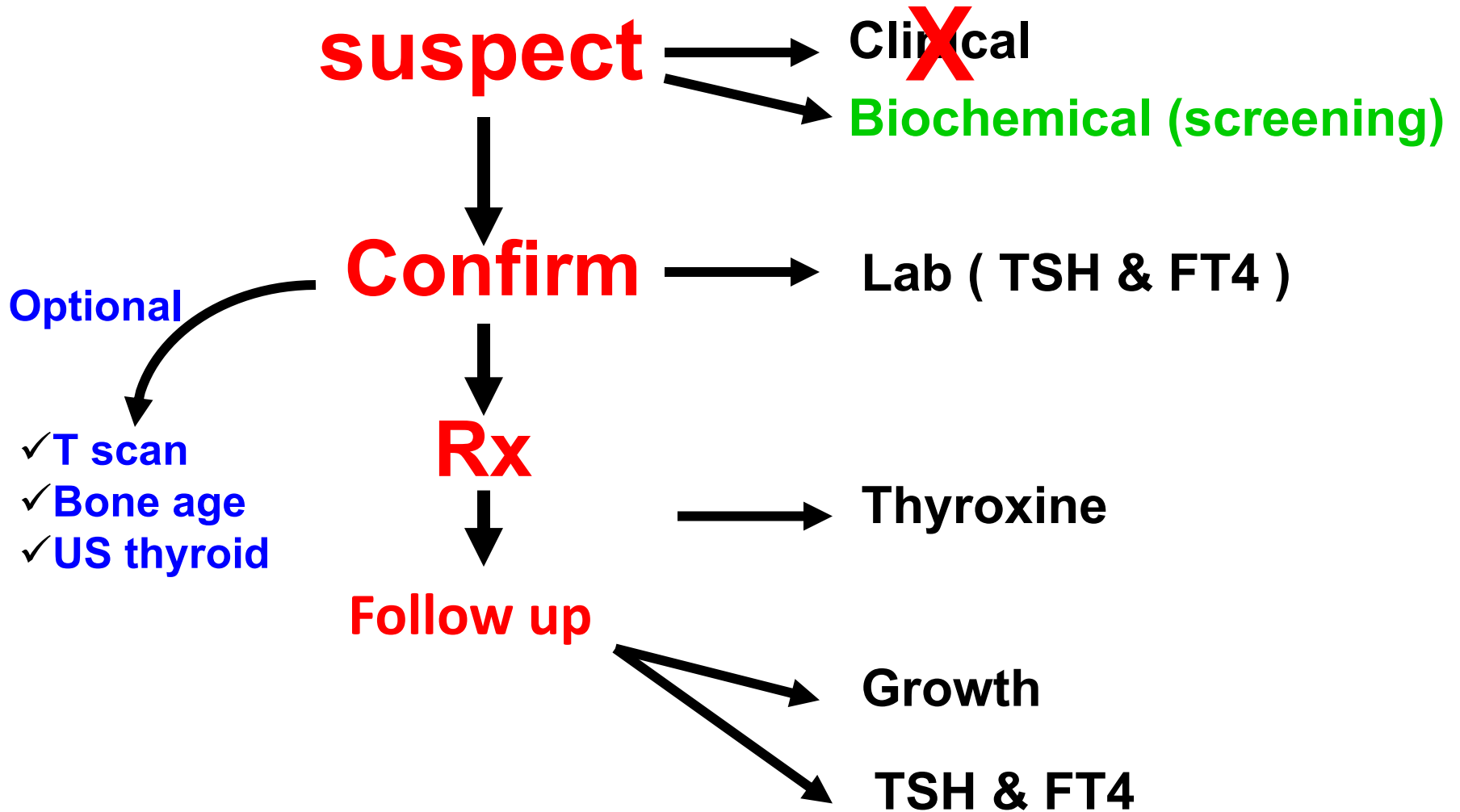


B



C

# Congenital Hypothyroidism



# Management

*High TSH & Low T4*

**Levothyroxine (T4)**

## Dose

10 -15 ug/kg/day  
12 -17 ug/kg/day  
37.5 – 50 ug/day

Higher dose in  
Severe cases  
**T4 < 5ug/dl**

## Form

**Tablets**  
**25-50-75 ug**  
**Crush it, add to**  
**5-10 cc water**  
**Or milk**

## Goals

**Normal T4**  
**In 2 wks**  
**(upper 1/2 of N)**

**Normal TSH**  
**In one month**  
**(lower 1/2 of N)**



# Newborn Screening Criteria

- Aim is to identify affected infants before development of clinical signs
- High incidence 1/3,000 to 1/4,000
- Mental retardation if not treated
- Levothyroxine \$3.00

# Screening Technique

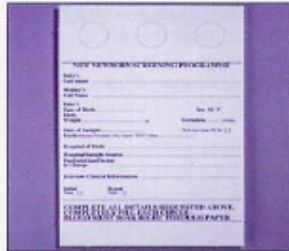
- Specimen is a blood spot on a filter paper
  - Obtained by heel prick
- Or
- cord blood
- TSH or TSH+FT4 or FT4

# Neonatal Screening

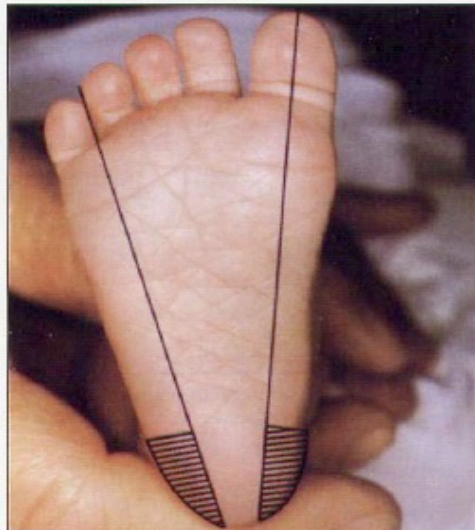
## *Blood Specimen Collection and Handling Procedure*

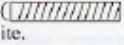


**1** Equipment: sterile lancet with tip approximately 2.0 mm, sterile alcohol prep, sterile gauze pads, soft cloth, blood collection form, gloves.



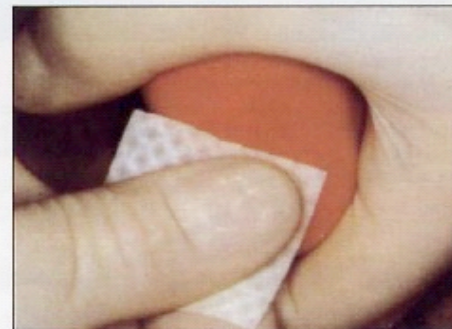
**2** Complete ALL information. Do not contaminate filter paper circles by allowing the circles to come in contact with spillage or by touching before or after blood collection. Keep "SUBMITTER COPY" if applicable.



**3** Hatched area (  ) indicates safe areas for puncture site.

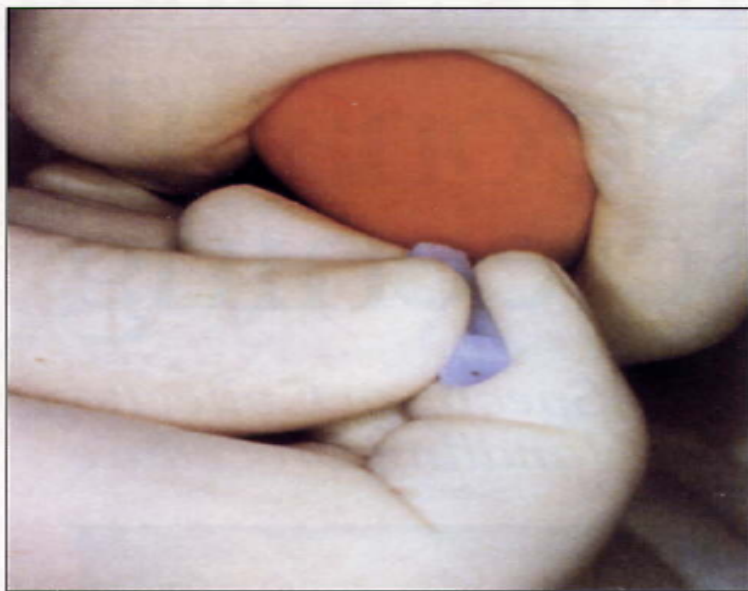


**4** Warm site with soft cloth, moistened with warm water up to 41°C, for three to five minutes.

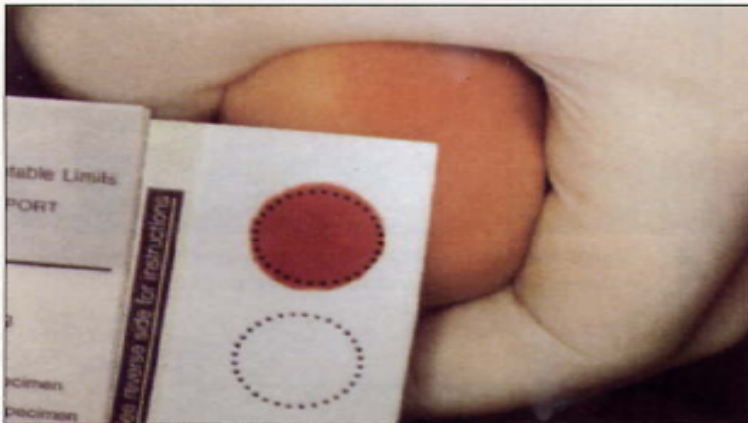


**5** Cleanse site with alcohol prep. Wipe DRY with sterile gauze pad.





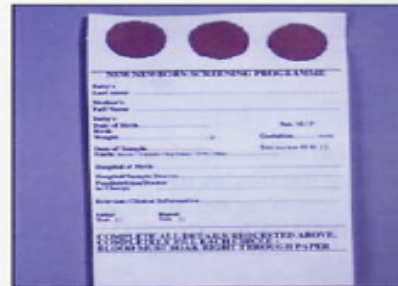
**6** Puncture heel. Wipe away first blood drop with sterile gauze pad. Allow another **LARGE** blood drop to form.



**7** Lightly touch filter paper to **LARGE** blood drop. Allow blood to soak through and completely fill circle with **SINGLE** application to **LARGE** blood drop. (To enhance blood flow, **VERY GENTLE** intermittent pressure may be applied to area surrounding puncture site). Apply blood to one side of filter paper only.



**8** Fill remaining circles in the same manner as step 7, with successive blood drops. If blood flow is diminished, repeat steps 5 through 7. Care of skin puncture site should be consistent with your institution's procedures.



**9** Dry blood spots on a dry, clean, flat non-absorbent surface for a minimum of four hours.



**10** Mail completed form to testing laboratory within 24 hours of collection.

# Good Specimen

FILL FIVE CIRCLES WITH BLOOD



BE SURE IT SOAKS THROUGH

# **IQ Outcome**

**Pre-screening**

• **76**

**Post-screening**

• **104**



**> screening**



**< screening**







**A man and 3 females (age range, 17-20 y) with myxedematous cretinism from the Republic of the Congo in Africa, a region with severe iodine deficiency.**

# Treatment of Hypothyroidism

- Replacement thyroid hormone medication:  
**Thyroxine**

# Your turn

- 2 days old baby has a TSH= 150, FT4= 5 on newborn screening. what is your next best step:
  - A. Repeat TSH, FT4, follow up in 1 week
  - B. Do US thyroid after 1 week
  - C. Start levothyroxin 50mcg
  - D. repeat TSH, FT4 and start treatment



**HYPERTHYROIDISM**

# Causes of hyperthyroidism

- Graves Disease
- Overtreatment with thyroxine
- Thyroid adenoma (rare)
- Transient neonatal thyrotoxicosis

# Hyperthyroidism

- Increased thyroid hormone levels
  - ↑ T4 +/- High T3
  - ↓ TSH (suppressed)

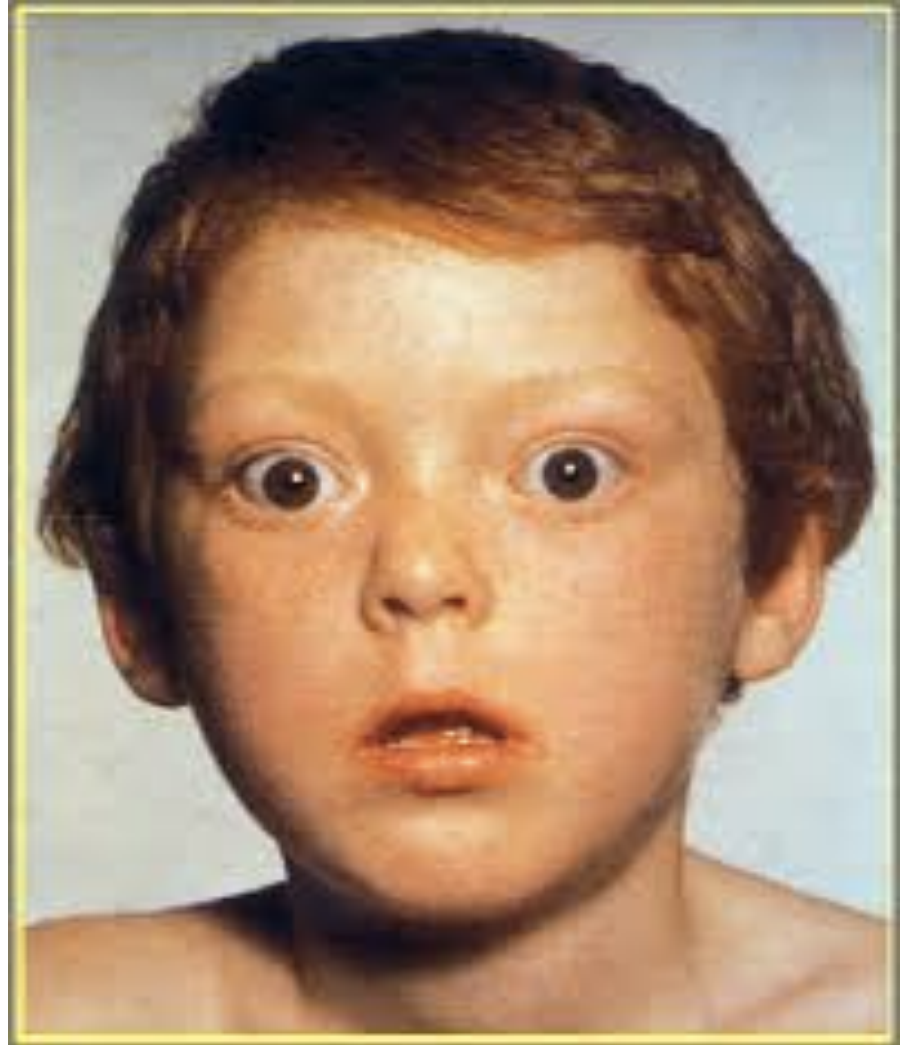
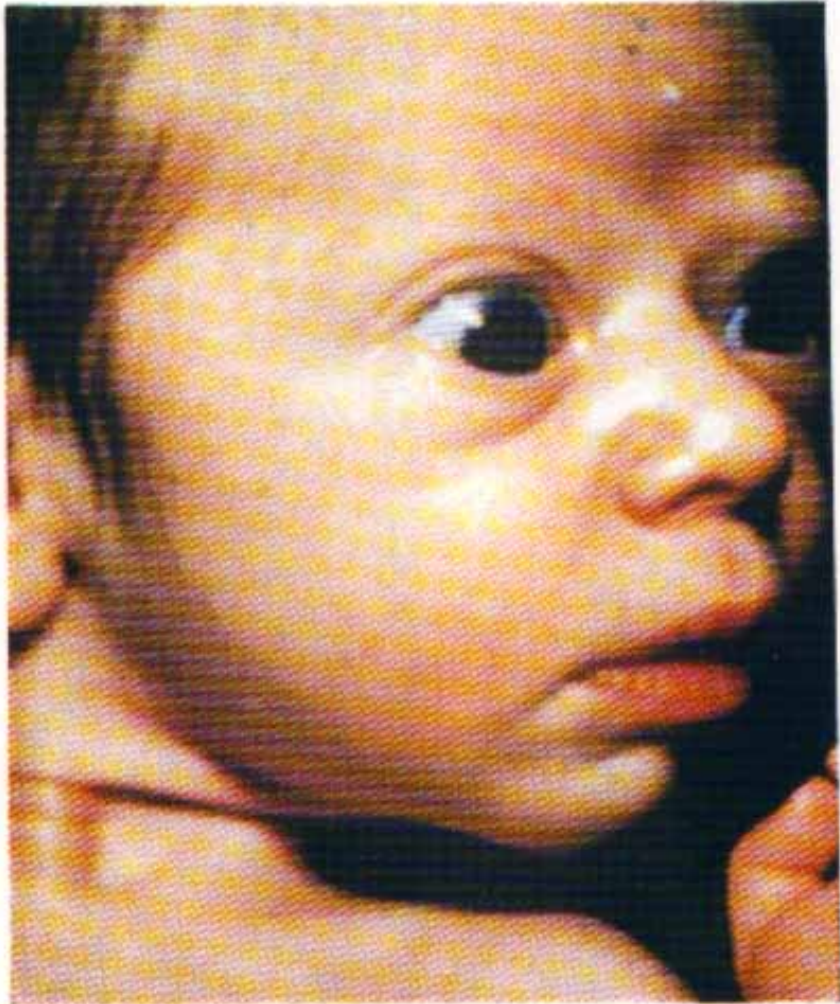
# Graves' Disease

- Most common cause of hyperthyroidism
- Autoimmune process
- TSH-R stimulating antibody
- 40-70% relapse after 2 years of treatment

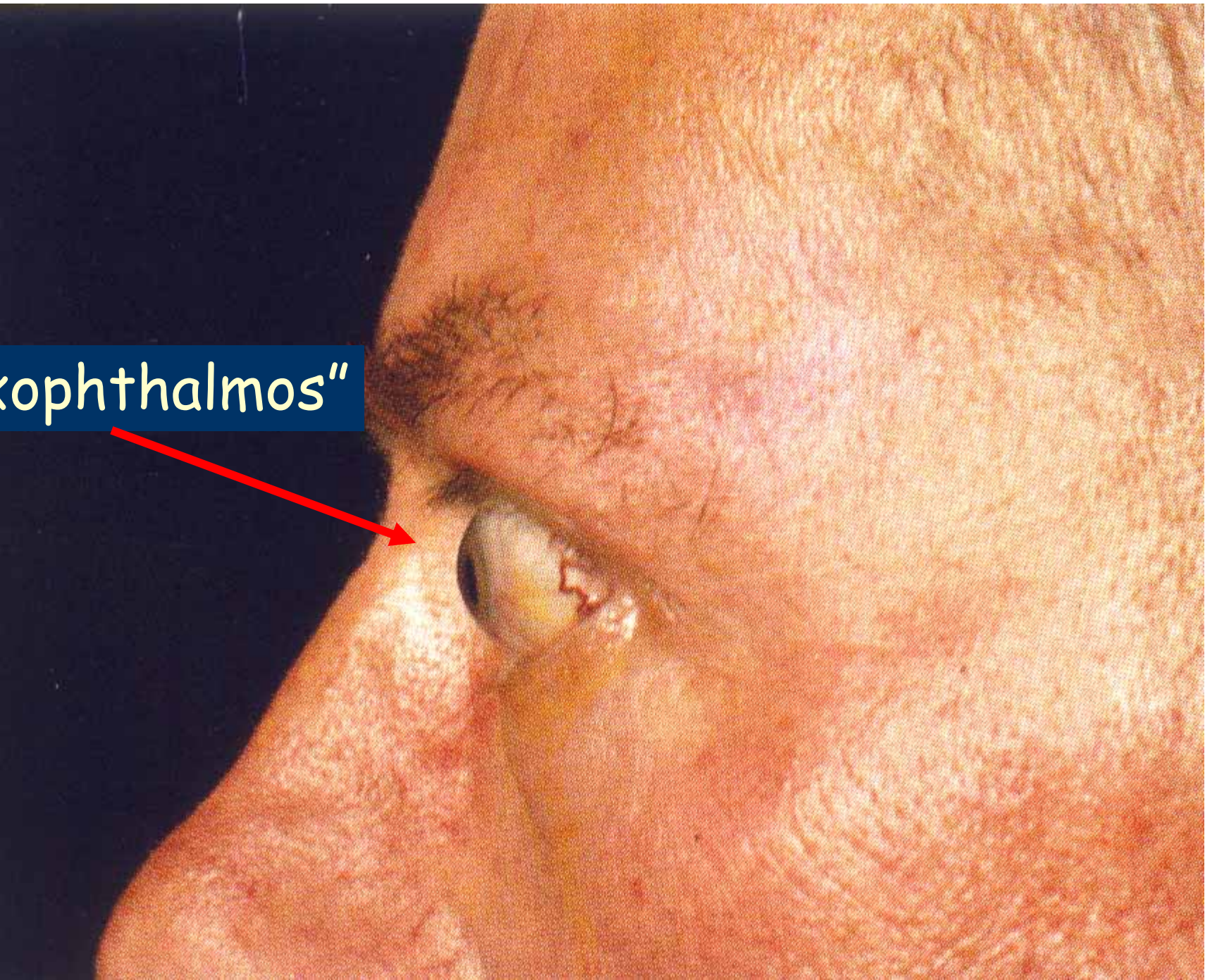


# Clinical manifestations

- Heat intolerance
- Hyperactivity, irritability
- Weight loss
- normal to increased appetite
- diarrhea
- Tremor, Palpitations
- sweating
- Lid retraction & Lid Lag (thyroid stare)
- Proptosis
- menstrual irregularity
- Goitre



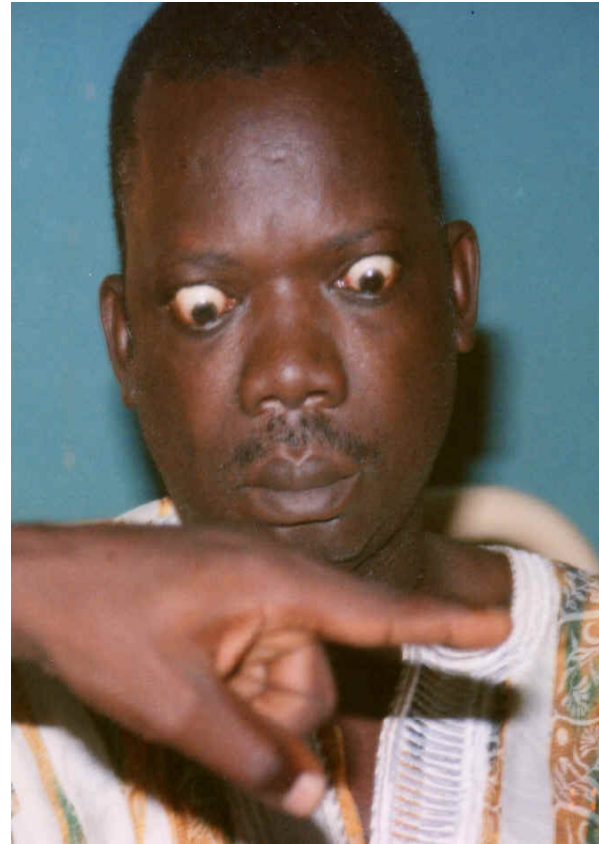
"Exophthalmos"





Grave's  
ophthalmopathy

# Hyperthyroid Eye Disease



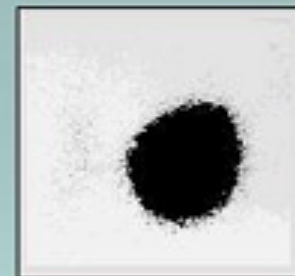
# Investigations

- TSH, free T3&T4
- Thyroid antibodies (TSH receptors antibodies)
- Radionucleotide thyroid scan (increase uptake)

# Thyroid Scan in Thyrotoxicosis



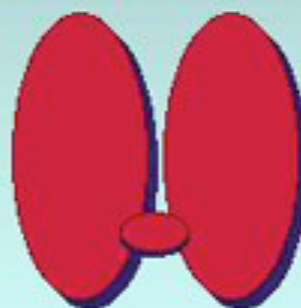
**Graves' Disease**



**Follicular Adenoma**



**Multinodular Goiter**



**Subacute Thyroiditis**

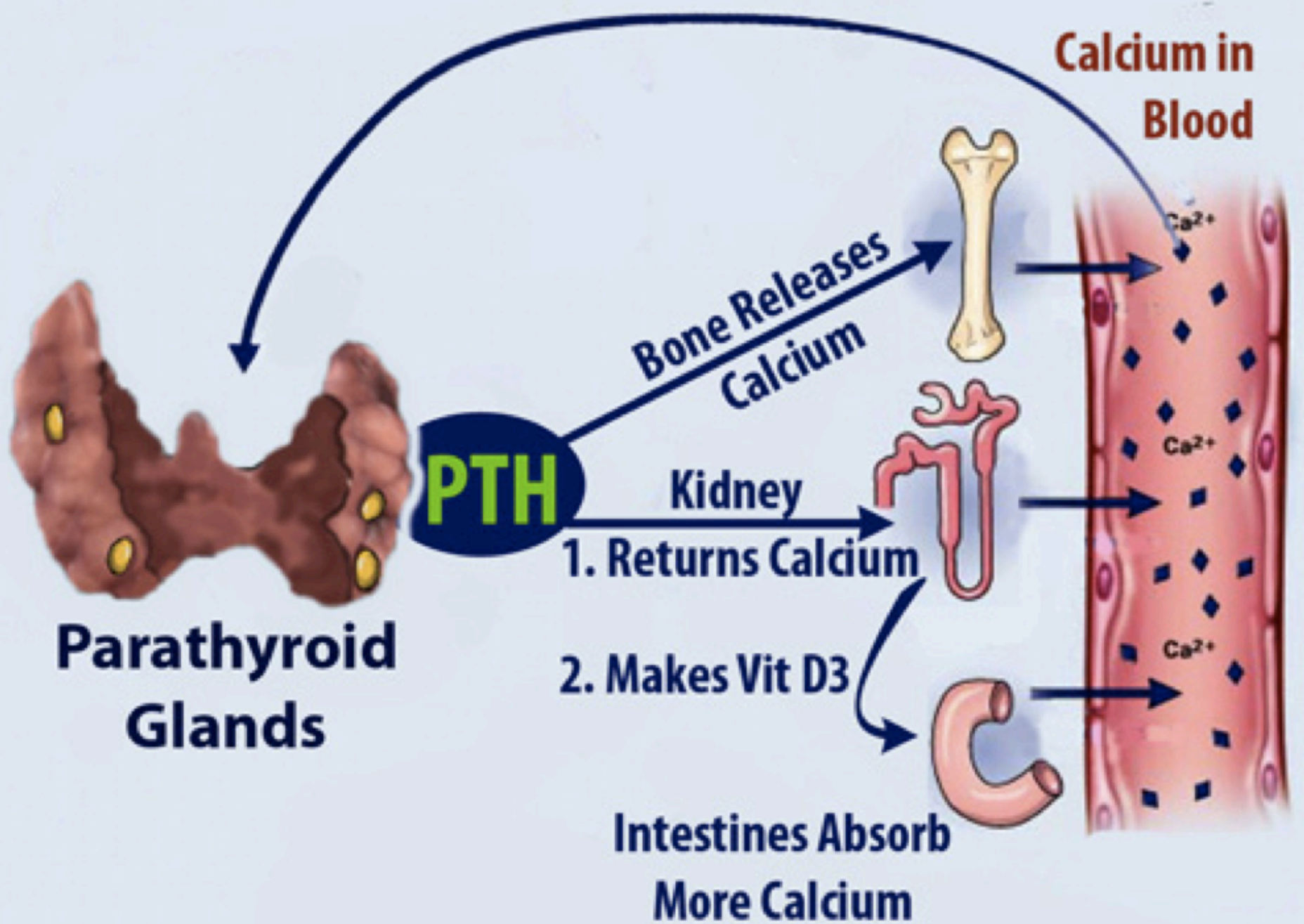
# Treatment

- *Beta*-blockers
- Carbimazole
- PTU (propylthiouracil)
- Radioactive iodine (in adults)
- surgery



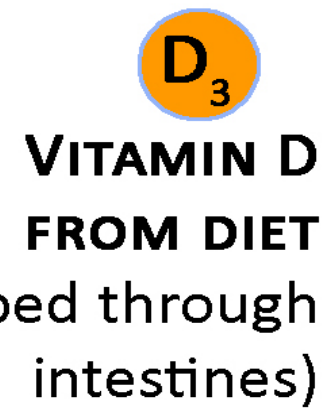
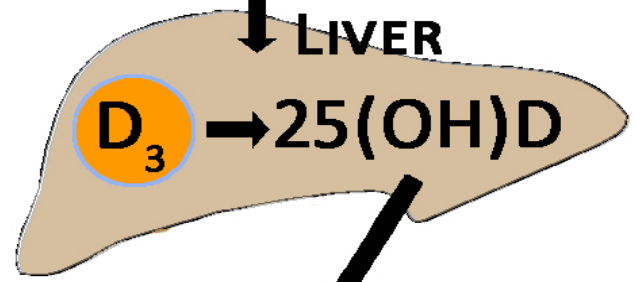
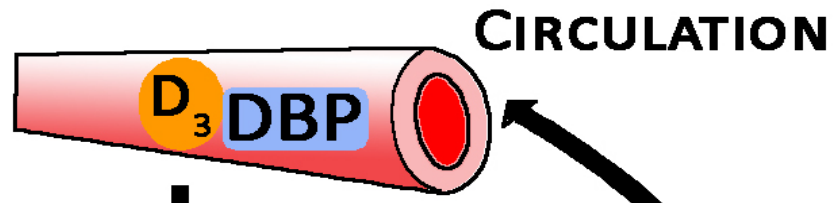
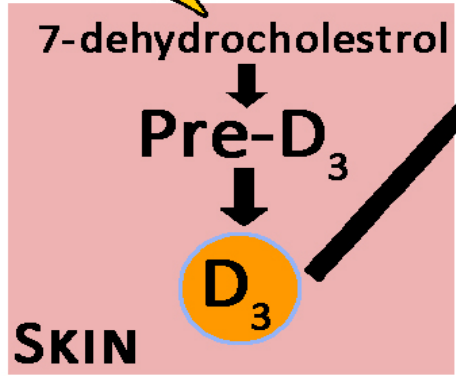


**RICKETS**



# SUN

## UVB



↑ Ca  
↑ Po4



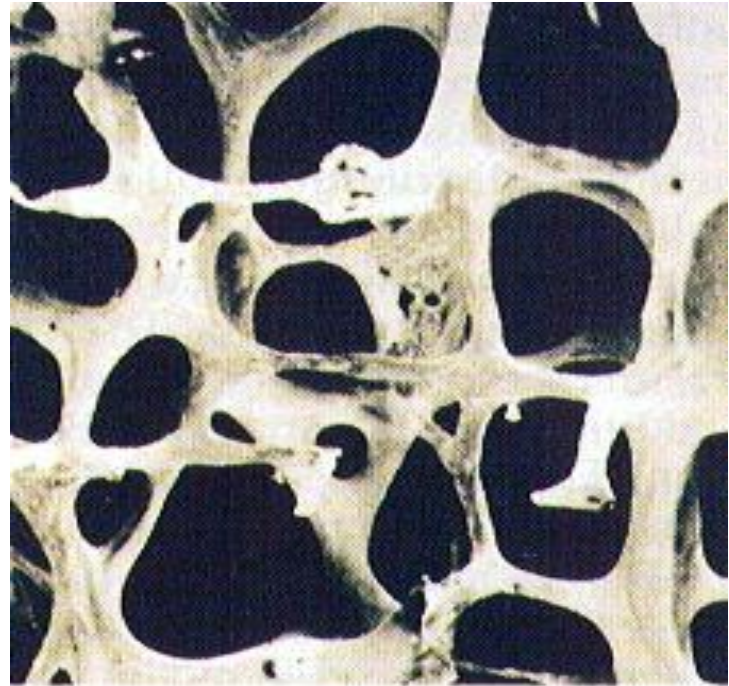
# Calcitonin

- It is a calcium lowering hormone
- Secreted by Thyroid C cells

*Anti - PTH*

# Rickets

- Reduced **mineralization** of bone matrix due to calcium deficiency.



# Rickets

## Vitamin D Deficiency

Nutritional

Intestinal malabsorption

anticonvulsants

Rickets of prematurity

Hepatobiliary

## Renal

Renal osteodystrophy:CRF

Familial hypophosphataemic rickets

Renal tubular acidosis

Fanconi syndrome

Vitamin D dependent type 1 rickets

Vitamin D dependent type 2 rickets

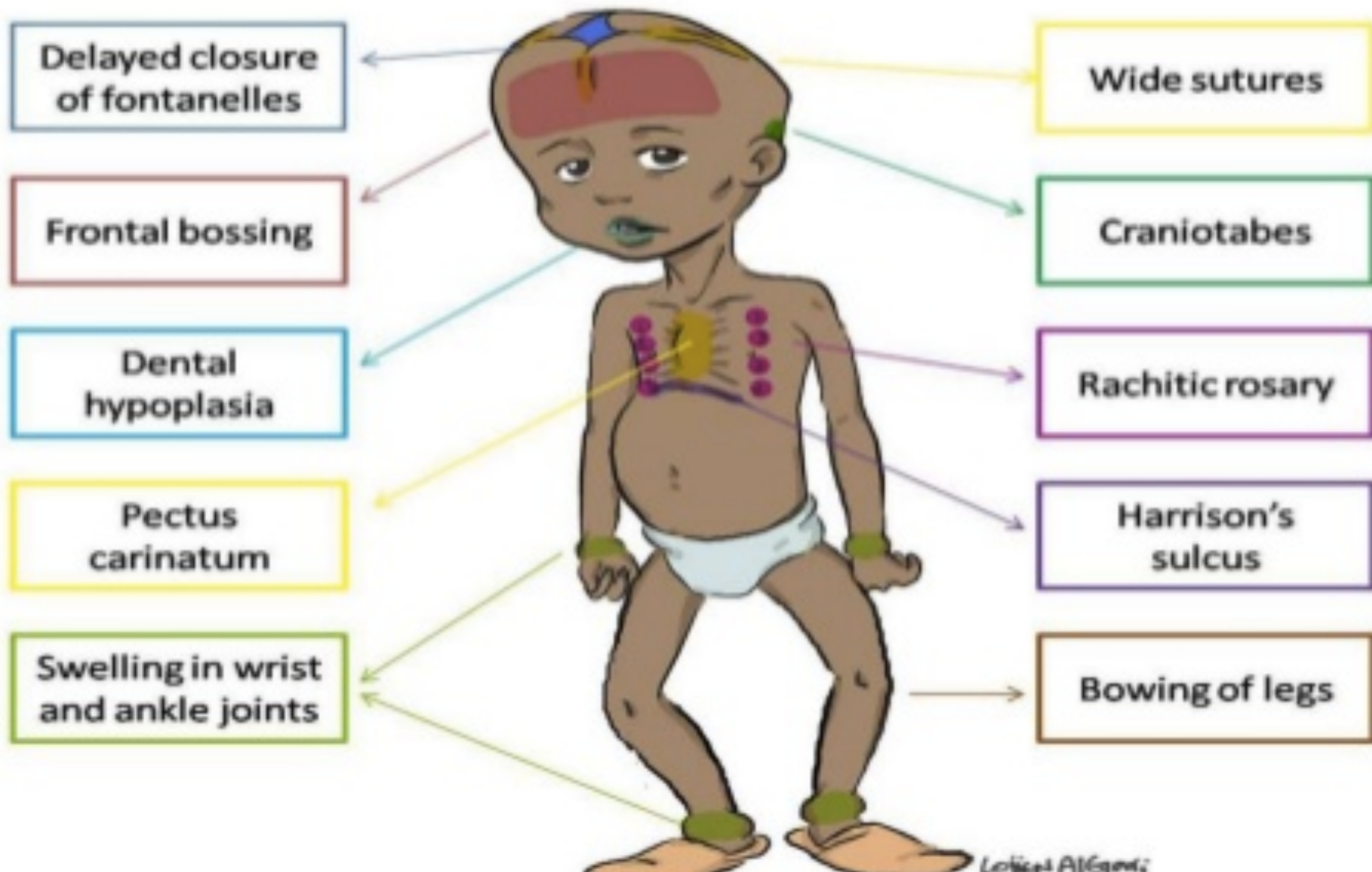
# Rickets Effect at growth end plate

Inadequate growth plate mineralization.

The growth plate increases in thickness.

The columns of cartilage cells are disorganized.

# 10 important clinical features in Rickets





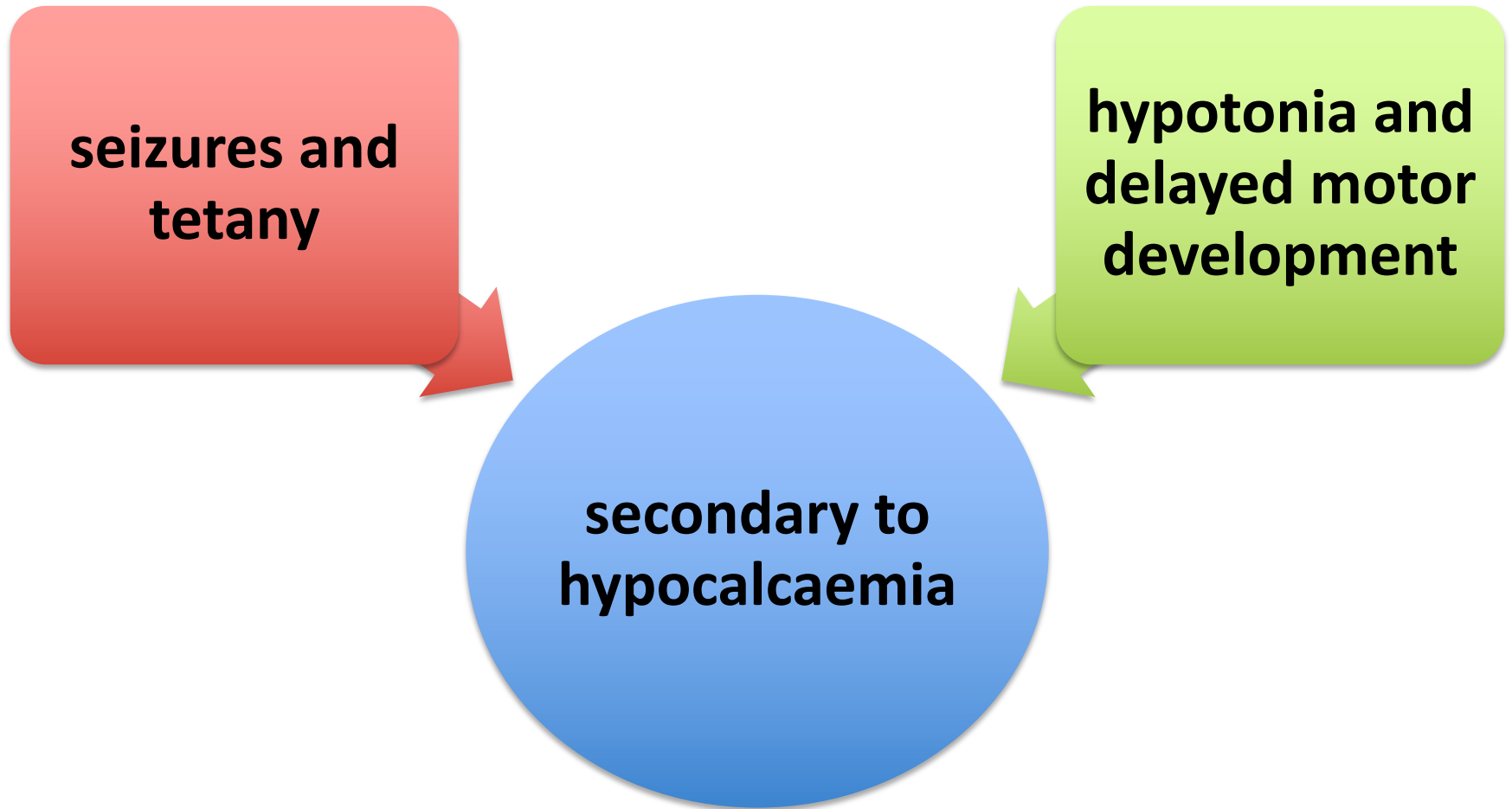








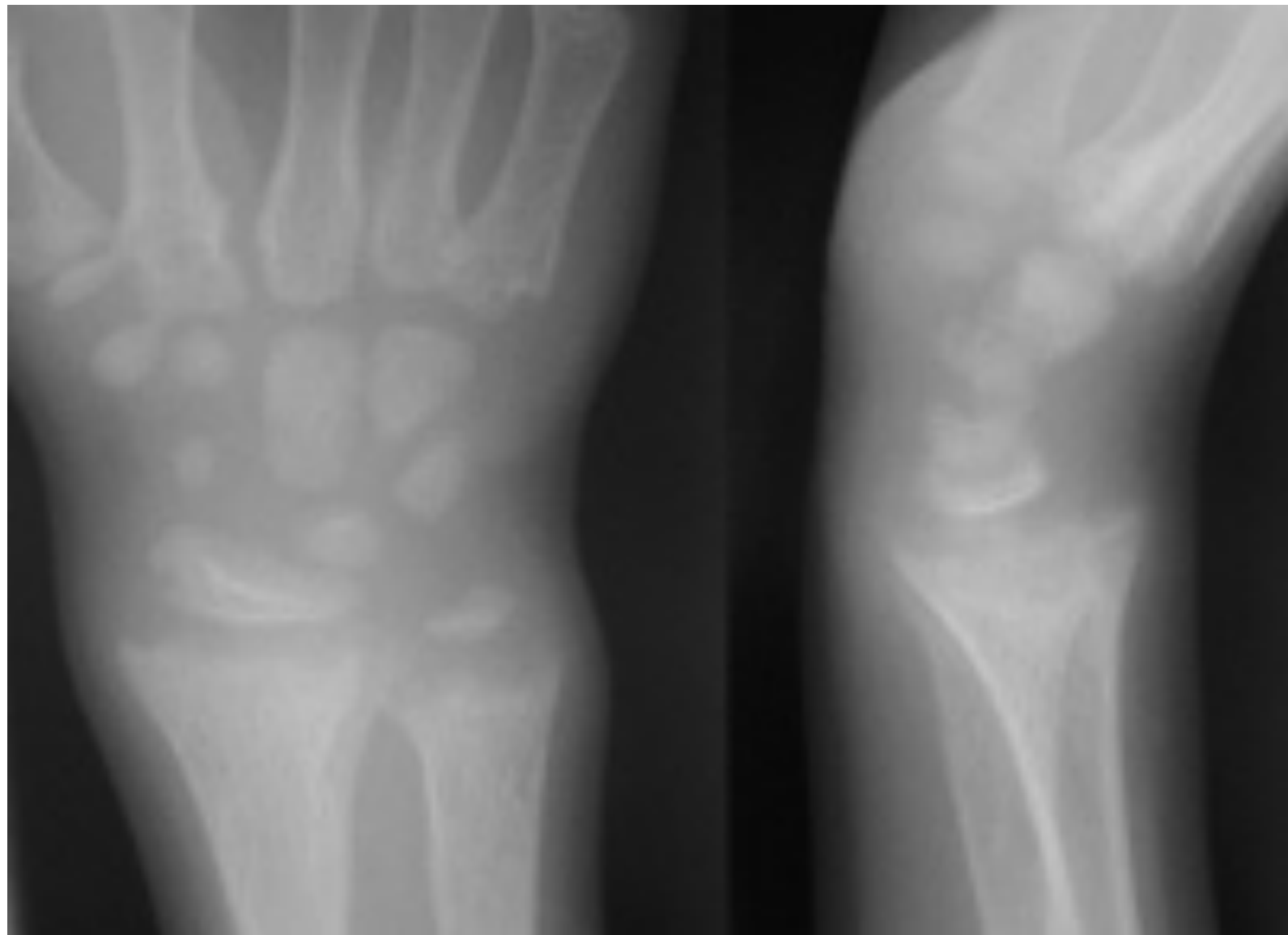
# Extra – skeletal manifestations



# Investigations

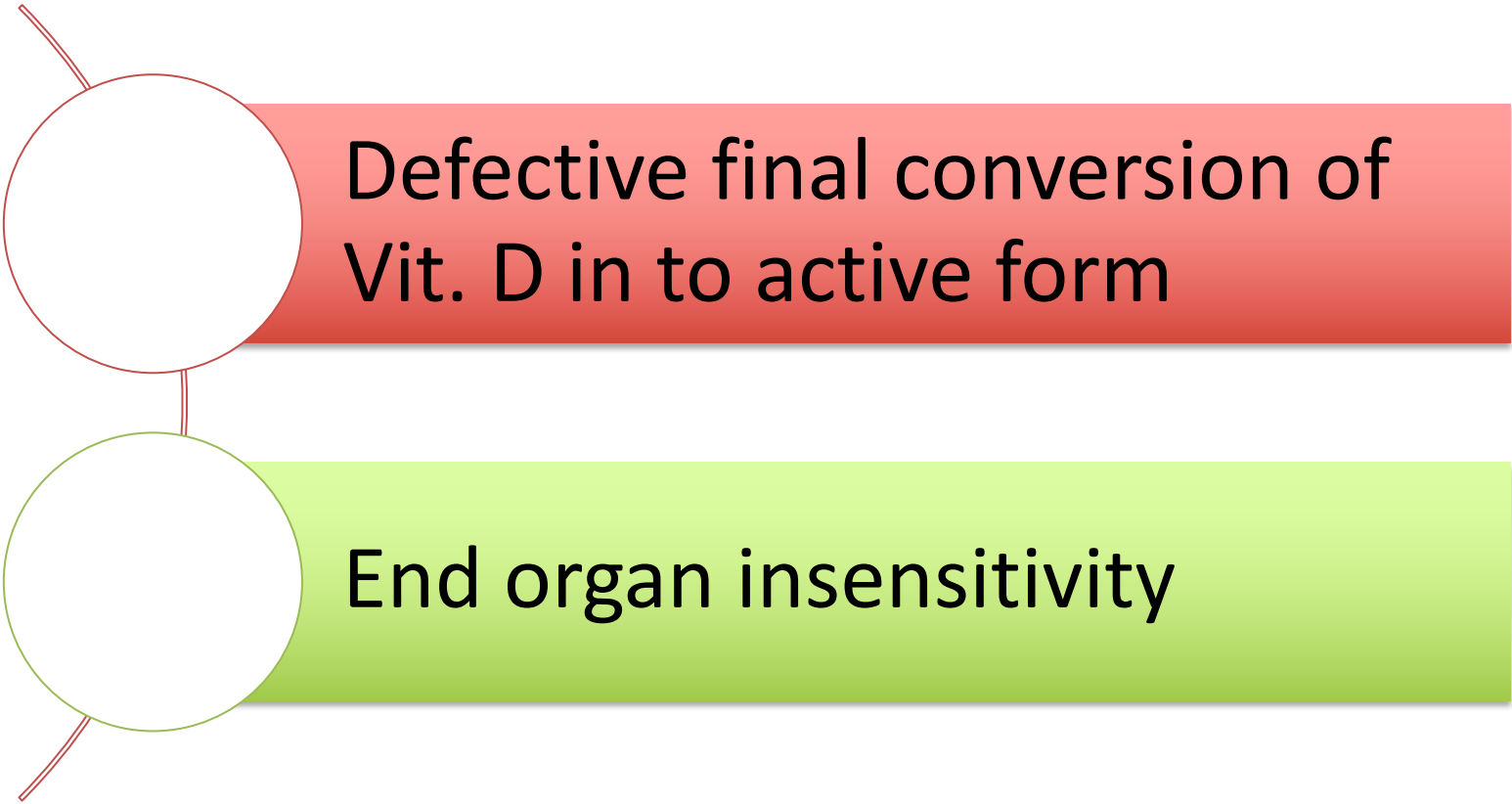
- ↓ or normal serum Ca
- ↓ Phosphorus
- ↑ alkaline phosphatase
- ↓ Vit D level
- ↑ Parathyroid hormone

0900



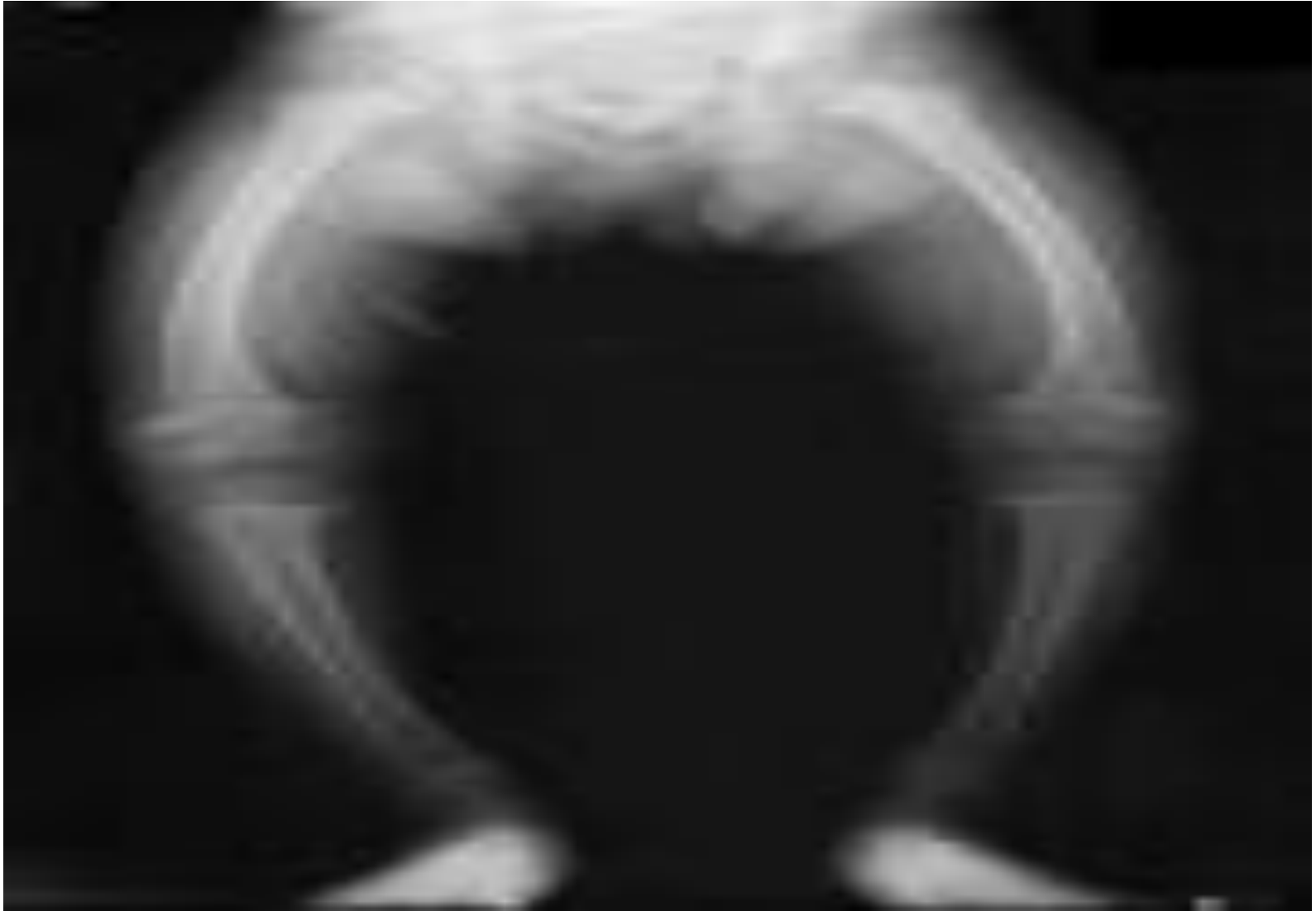


# Vitamin D Resistant Rickets



Defective final conversion of  
Vit. D in to active form

End organ insensitivity



Vitamin D Resistant Rickets

# Treatment of Rickets

- Vitamin D supplement
- Type and dose depends on underline cause of Rickets

Full term 1 year old girl who presented with afebrile tonic clonic convulsions. she has no chronic illnesses or medication. On examination he has no apparent dysmorphic features and his vital signs were normal.

Labs are most likely to show:

- A ↓ Ca, ↓ Phosphorus, ↑ ALP
- B ↓ Parathyroid hormone
- C ↓ Ca, ↑ Phosphorus, ↑ ALP
- d ↓ Ca, ↑ Phosphorus, ↓ ALP



