



Common Thyroid & calcium Disorders in Children

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Consultant

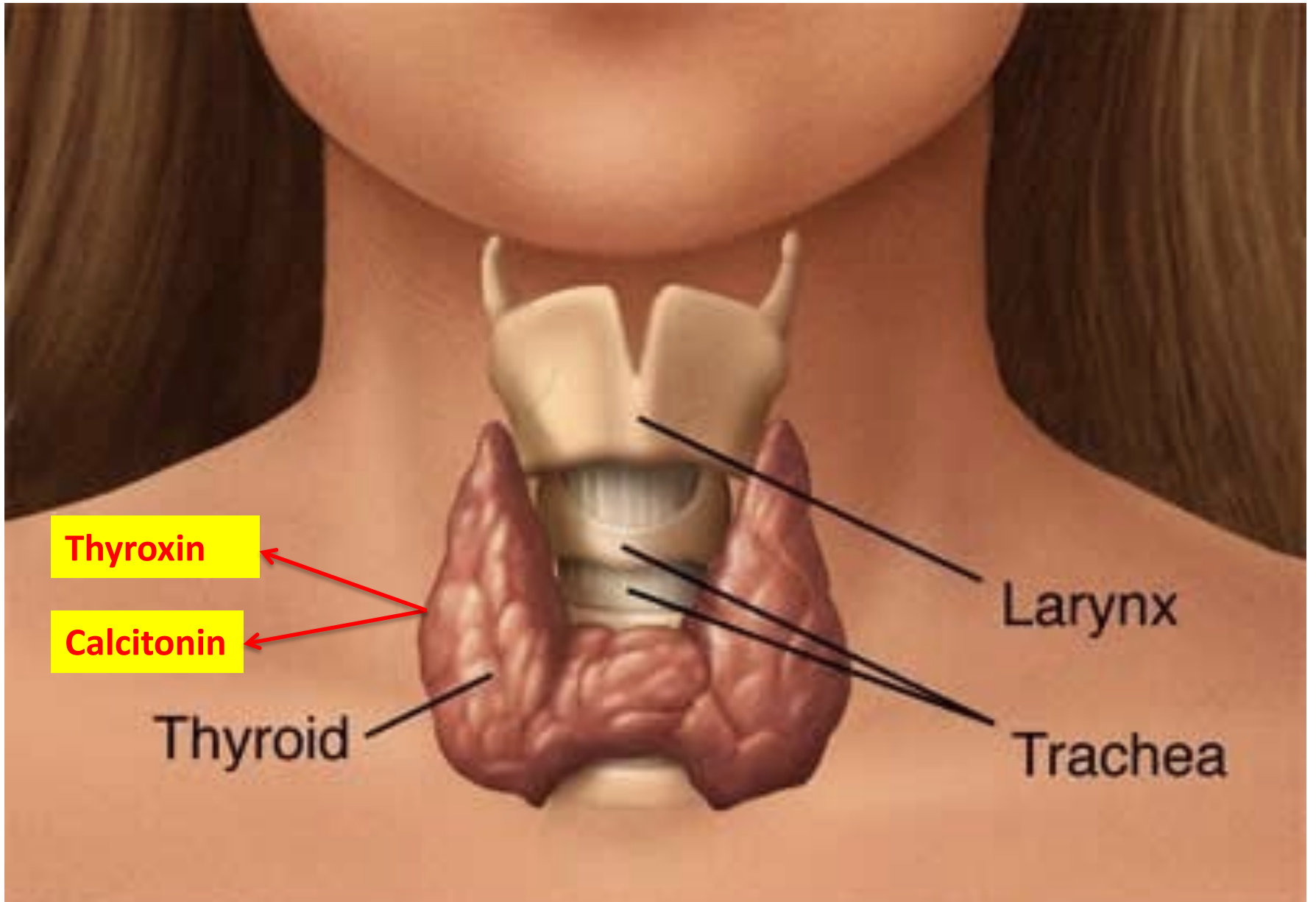
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Objectives

- Thyroid Anatomy and physiology
- Hypothyroidism
- Hyperthyroidism
- Rickets



Thyroxin

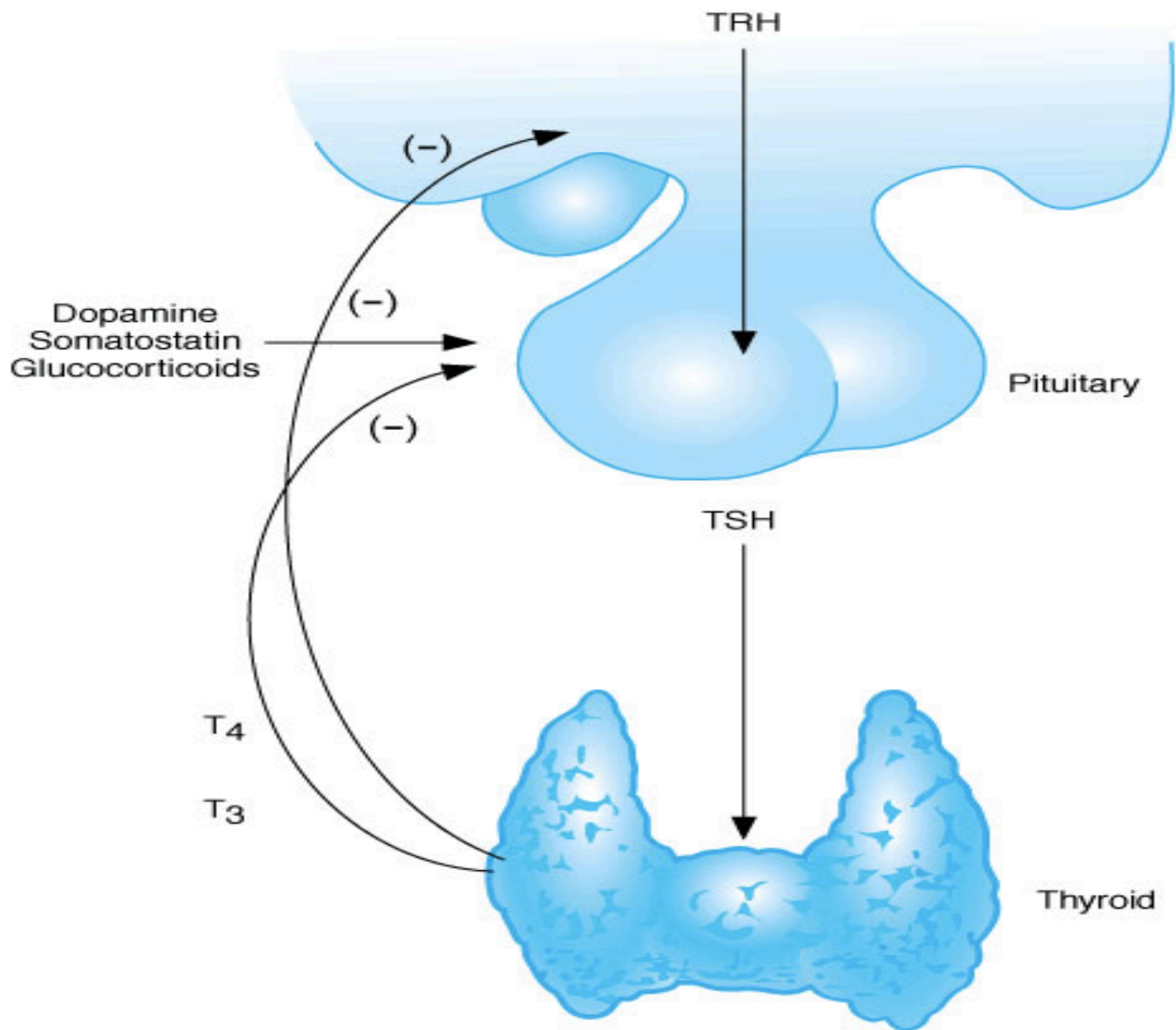
Calcitonin

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>
Potency	1	10
Protein Bound	10-20	1
Half-Life	5-7d	< 24h
Secreted by thyroid	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

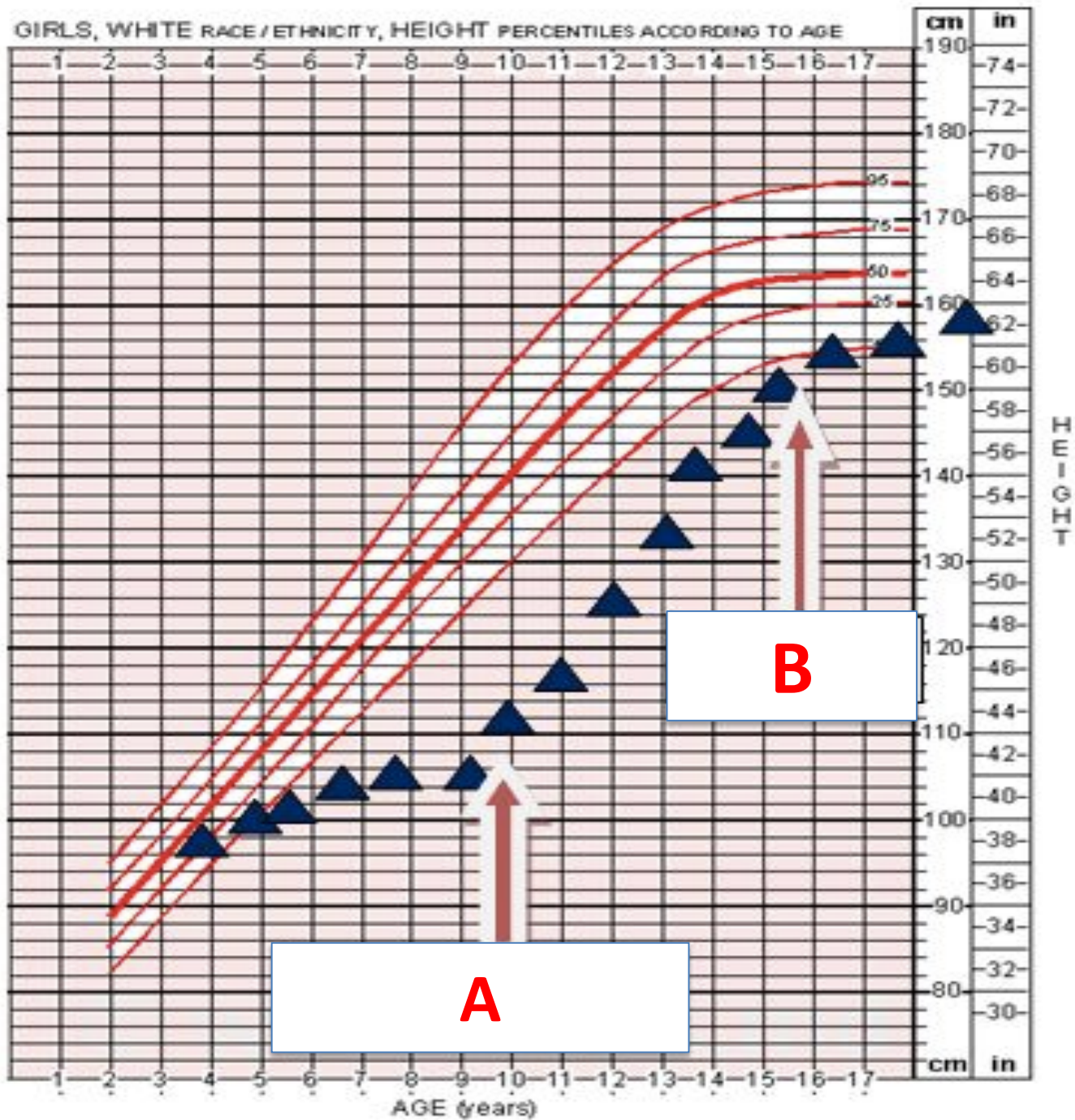
Secondary

- TSH deficiency
- TRH deficiency

Clinical features

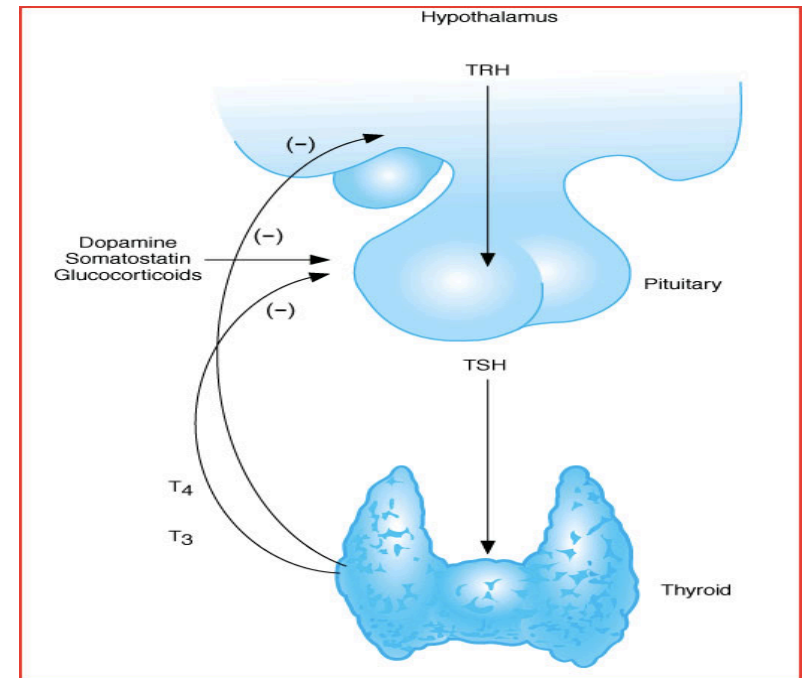
- Poor growth Stop growing
- Delayed bone age
- Poor school performance
- Delayed puberty
- Weight gain
- Fatigue
- Constipation
- Goiter
- Dry skin
- Cold Intolerance
- Sinus Bradycardia
- Delayed reflexes

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



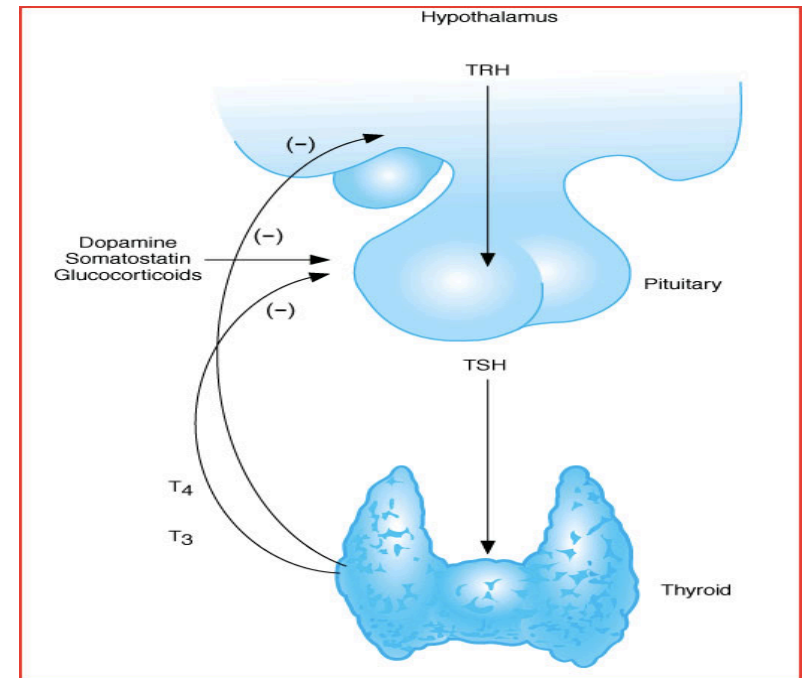
Primary Hypothyroidism

- 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

Age of Diagnosis	% with IQ > 85
3 months	78%
6 months	19%
> 7 months	0%

Congenital Hypothyroidism: Causes

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

Clinical Features of Congenital Hypothyroidism

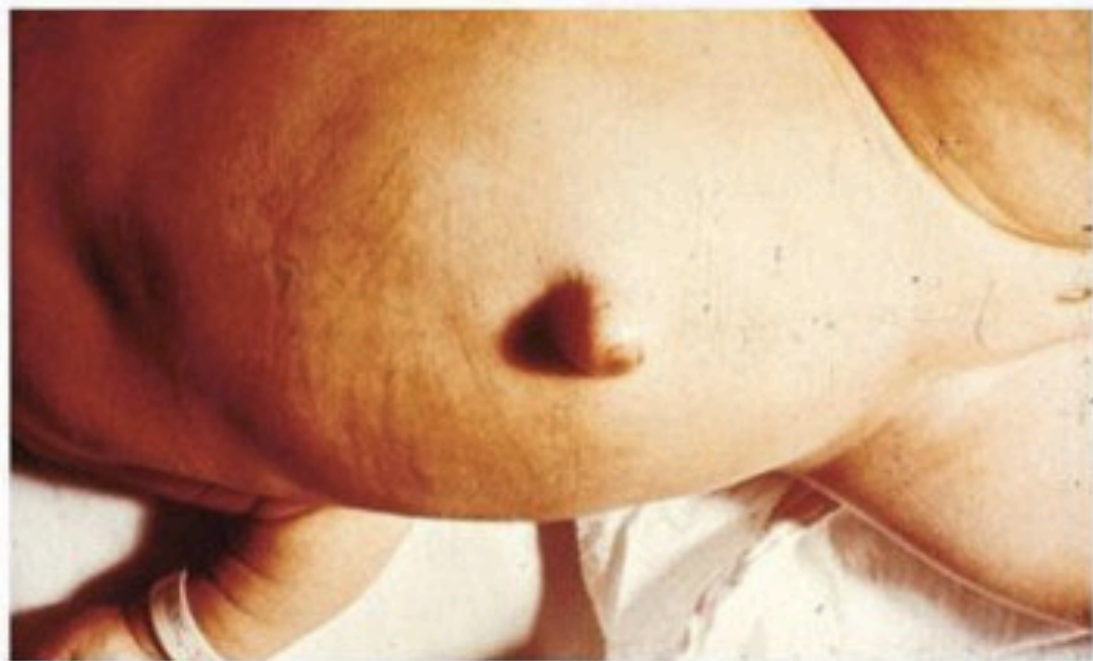
Finding	%
Lethargy	96%
Constipation	92%
Feeding problems	83%
Respiratory problems	76%
Dry skin	76%
Thick tongue	67%
Hoarse cry	67%
Umbilical hernia	67%
Prolonged jaundice	12%
Goiter	8%







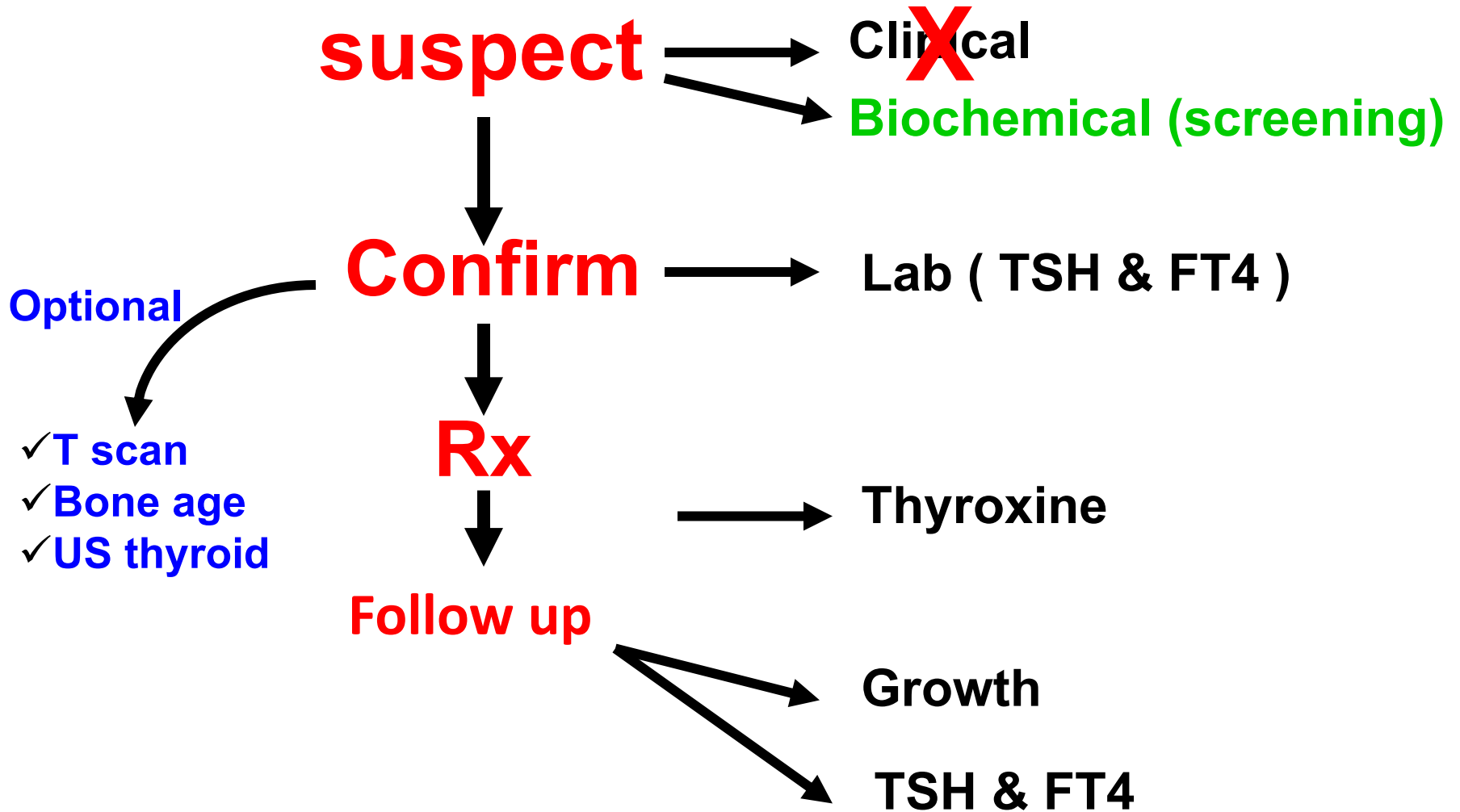
B



C

A

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

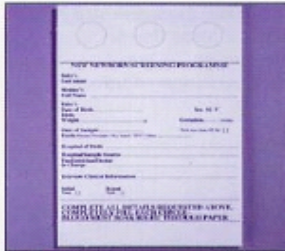
- Specimen is a blood spot on a filter paper
 - Obtained by heel prick
- Or
- cord blood
- TSH or TSH+FT4 or FT4

Neonatal Screening

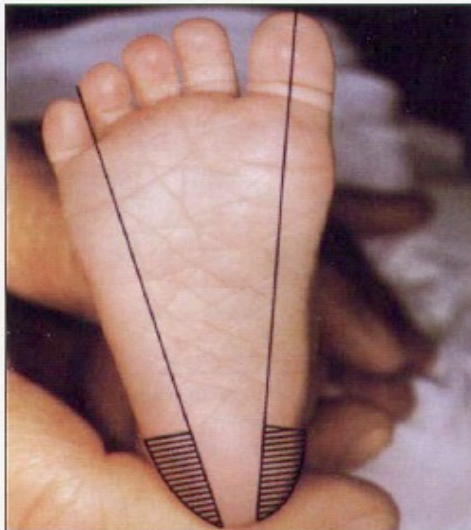
Blood Specimen Collection and Handling Procedure

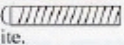


1 Equipment: sterile lancet with tip approximately 2.0 mm, sterile alcohol prep, sterile gauze pads, soft cloth, blood collection form, gloves.



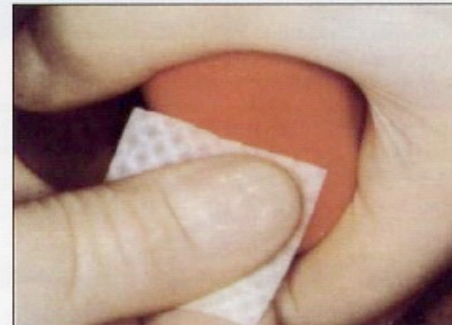
2 Complete ALL information. Do not contaminate filter paper circles by allowing the circles to come in contact with spillage or by touching before or after blood collection. Keep "SUBMITTER COPY" if applicable.



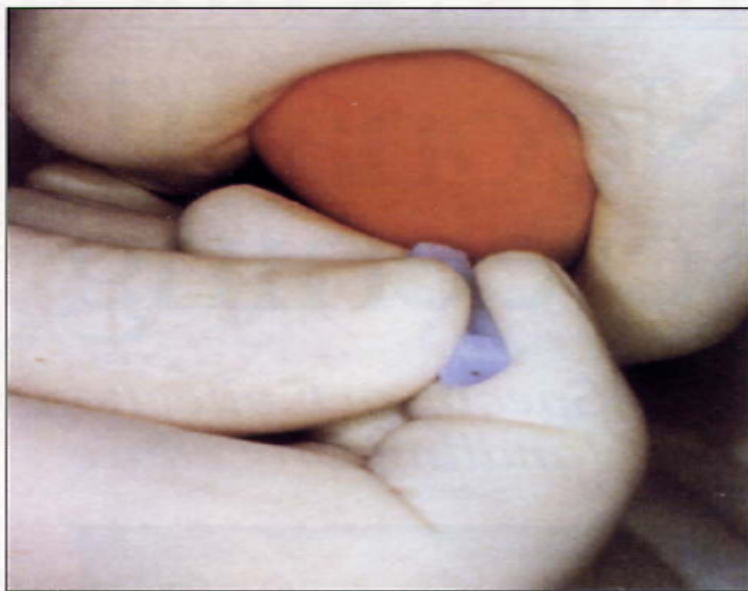
3 Hatched area () indicates safe areas for puncture site.



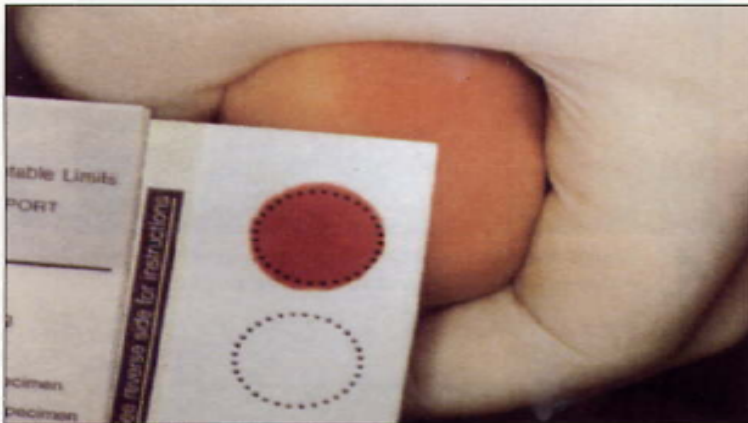
4 Warm site with soft cloth, moistened with warm water up to 41°C, for three to five minutes.



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



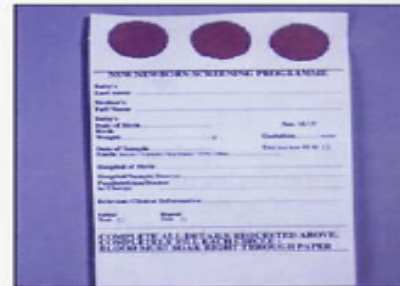
6 Puncture heel. Wipe away first blood drop with sterile gauze pad. Allow another **LARGE** blood drop to form.



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

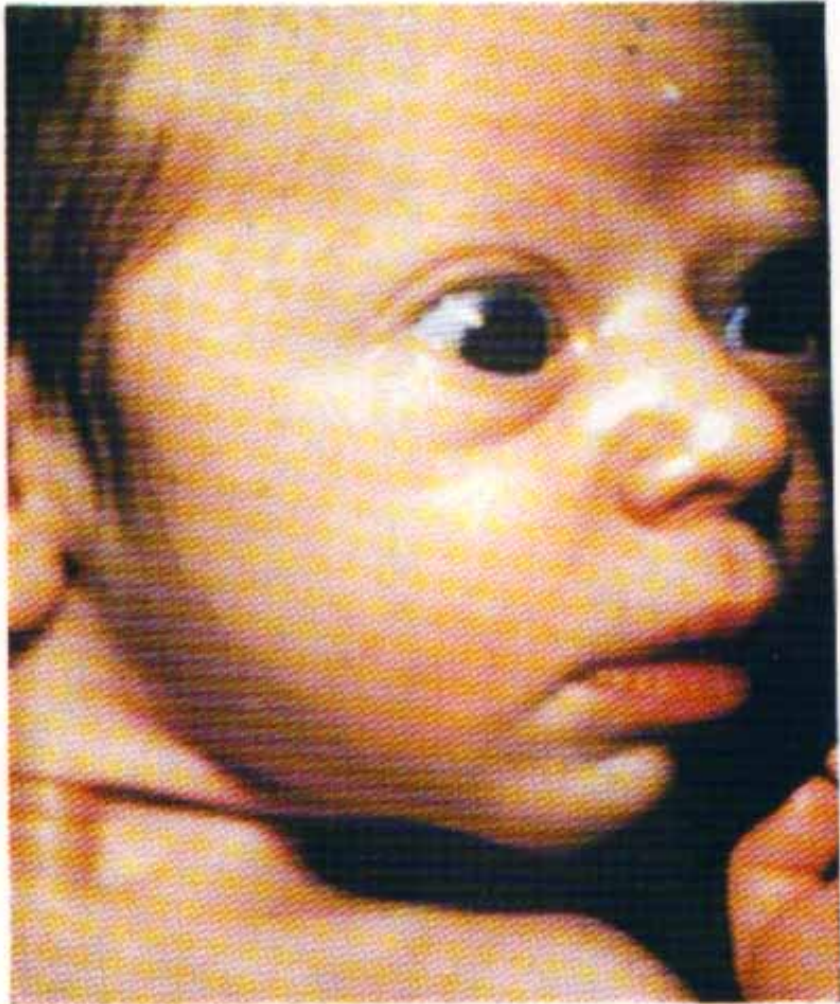
- Increased thyroid hormone levels
 - ↑ T4 +/- High T3
 - ↓ TSH (suppressed)

Graves' Disease

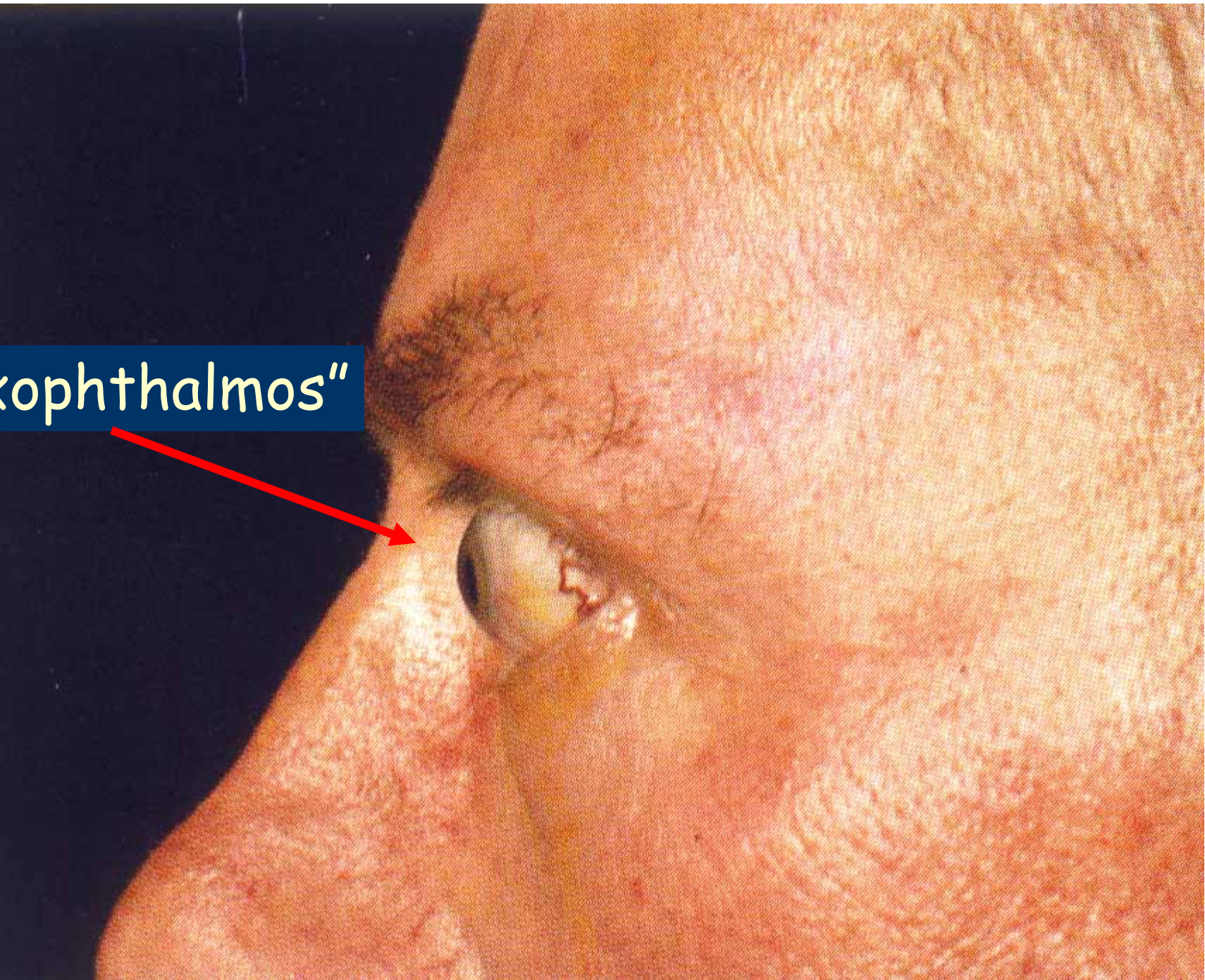
- Most common cause of hyperthyroidism
- Autoimmune process
- TSH-R stimulating antibody
- 40-70% relapse after 2 years of treatment

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



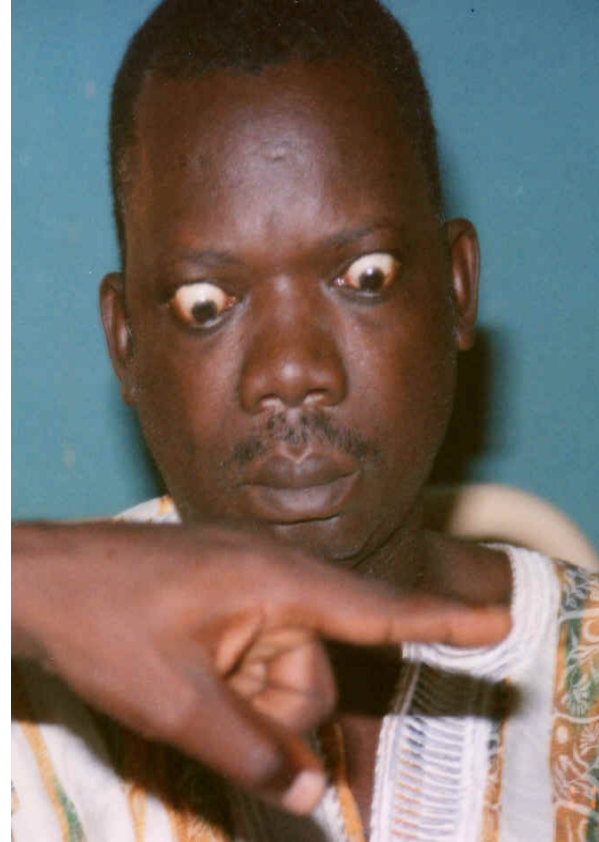
"Exophthalmos"





Grave's
ophthalmopathy

Hyperthyroid Eye Disease



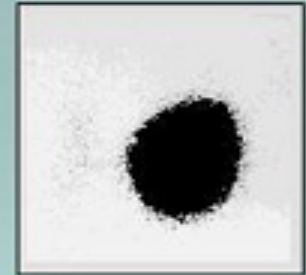
Investigations

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

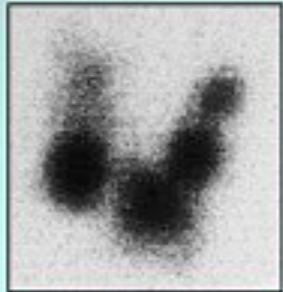
Thyroid Scan in Thyrotoxicosis



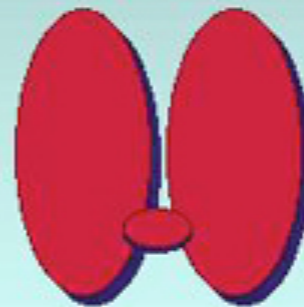
Graves' Disease



Follicular Adenoma



Multinodular Goiter



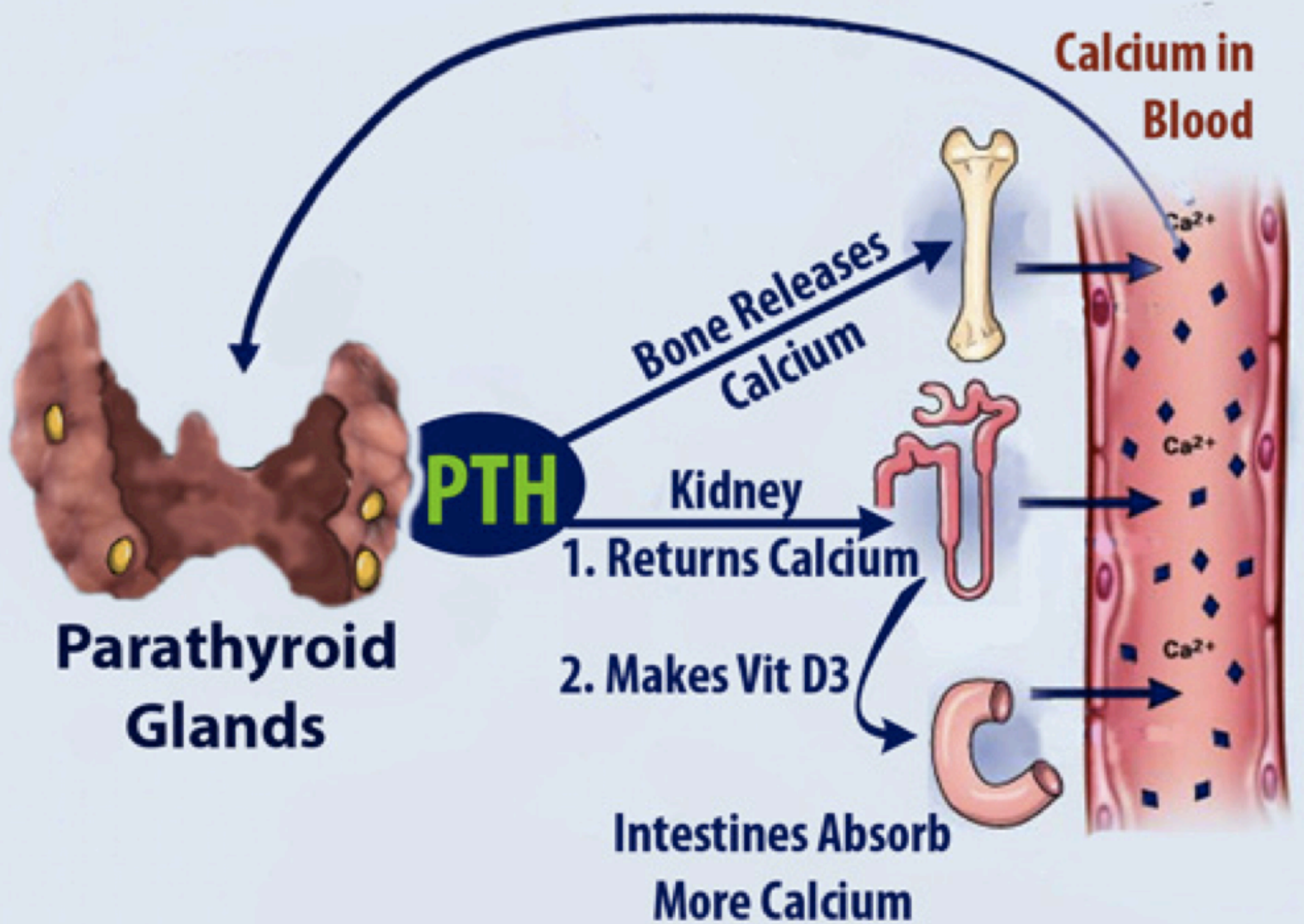
Subacute Thyroiditis

Treatment

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



RICKETS



SUN

UVB

7-dehydrocholesterol

Pre-D₃

D₃

SKIN

CIRCULATION

D₃ DBP

LIVER

D₃

25(OH)D

D₃

**VITAMIN D
FROM DIET
(absorbed through
intestines)**

↑ Ca

↑ Po4

Intestine

1α25(OH)D

KIDNEY

Bone

Immune
cells

↑ mineralization

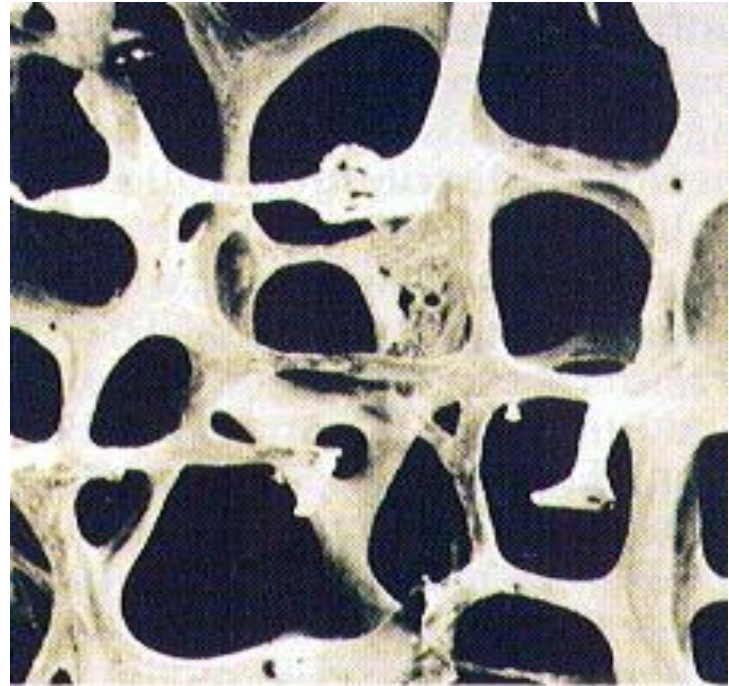
Calcitonin

- 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

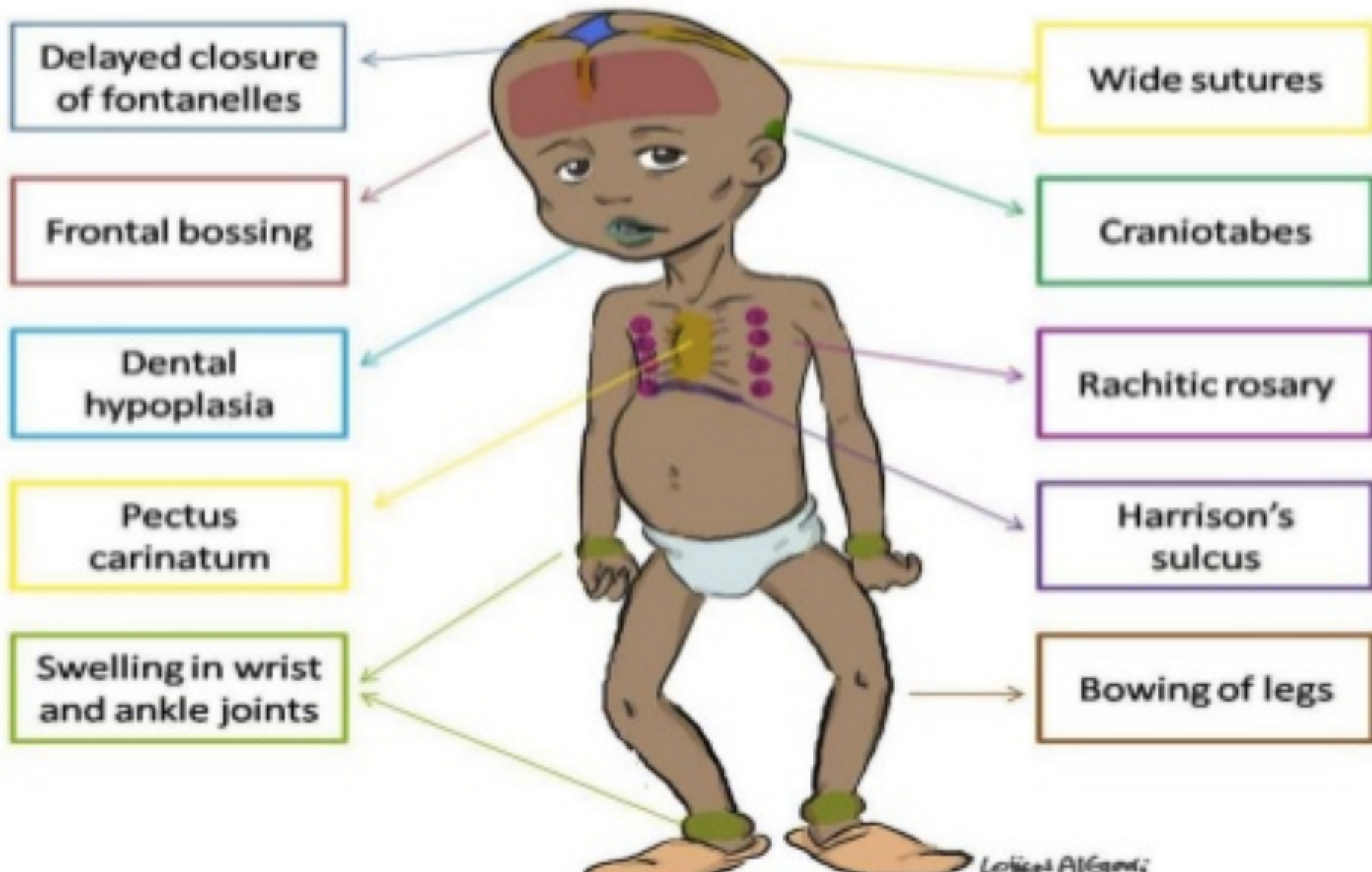
Rickets Effect at growth end plate

Inadequate growth plate mineralization.

The growth plate increases in thickness.

The columns of cartilage cells are disorganized.

10 important clinical features in Rickets



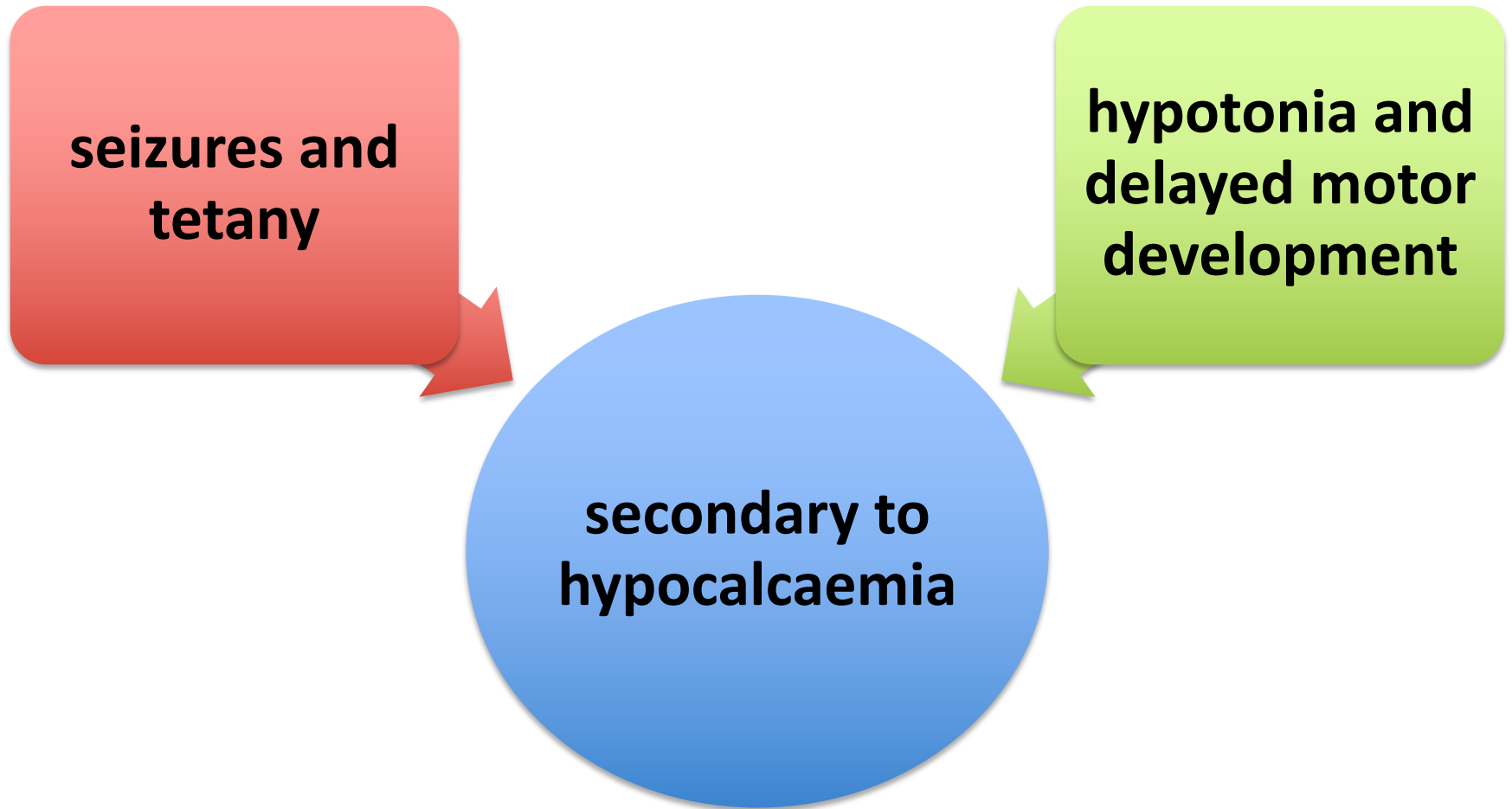








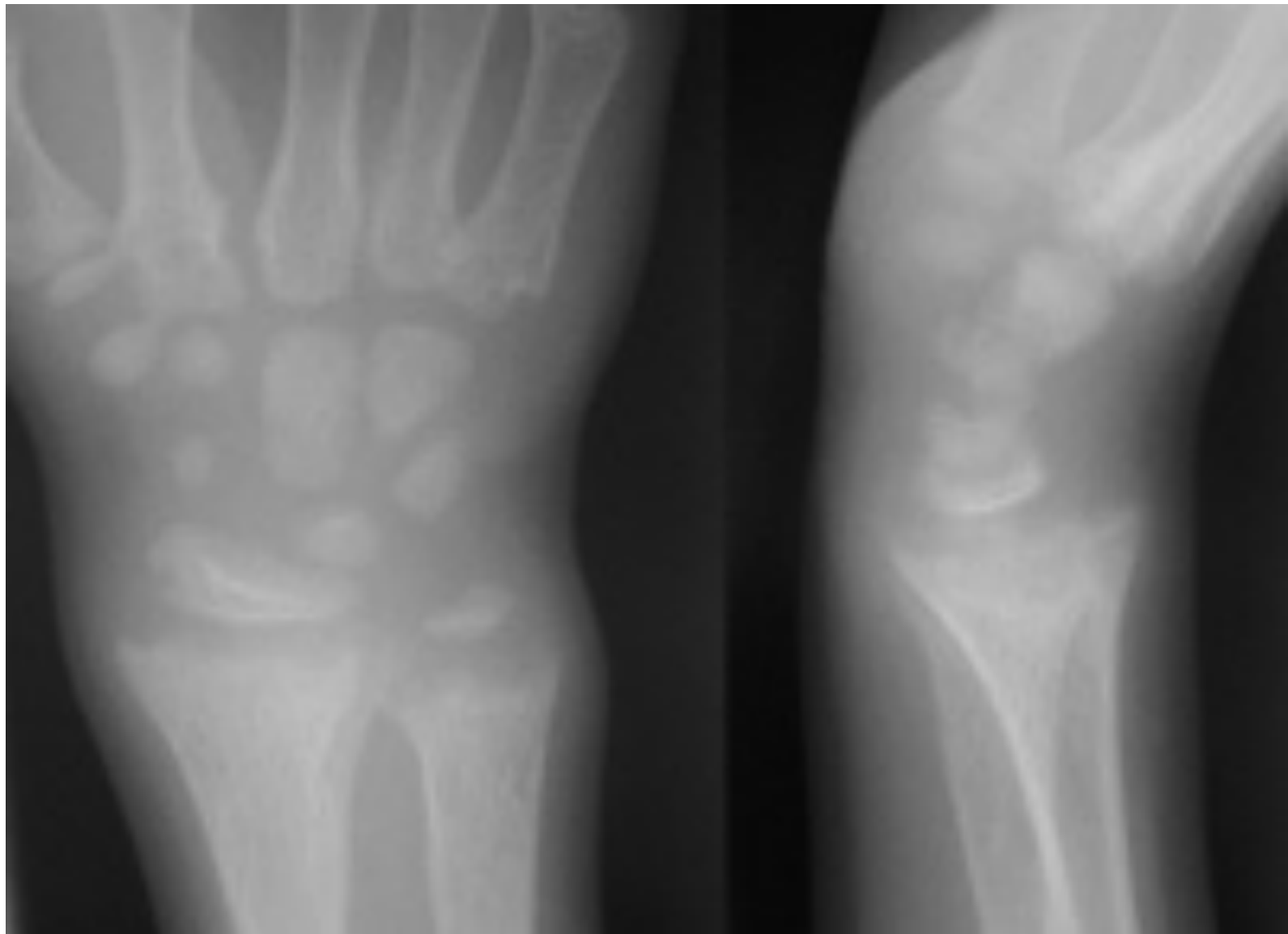
Extra – skeletal manifestations



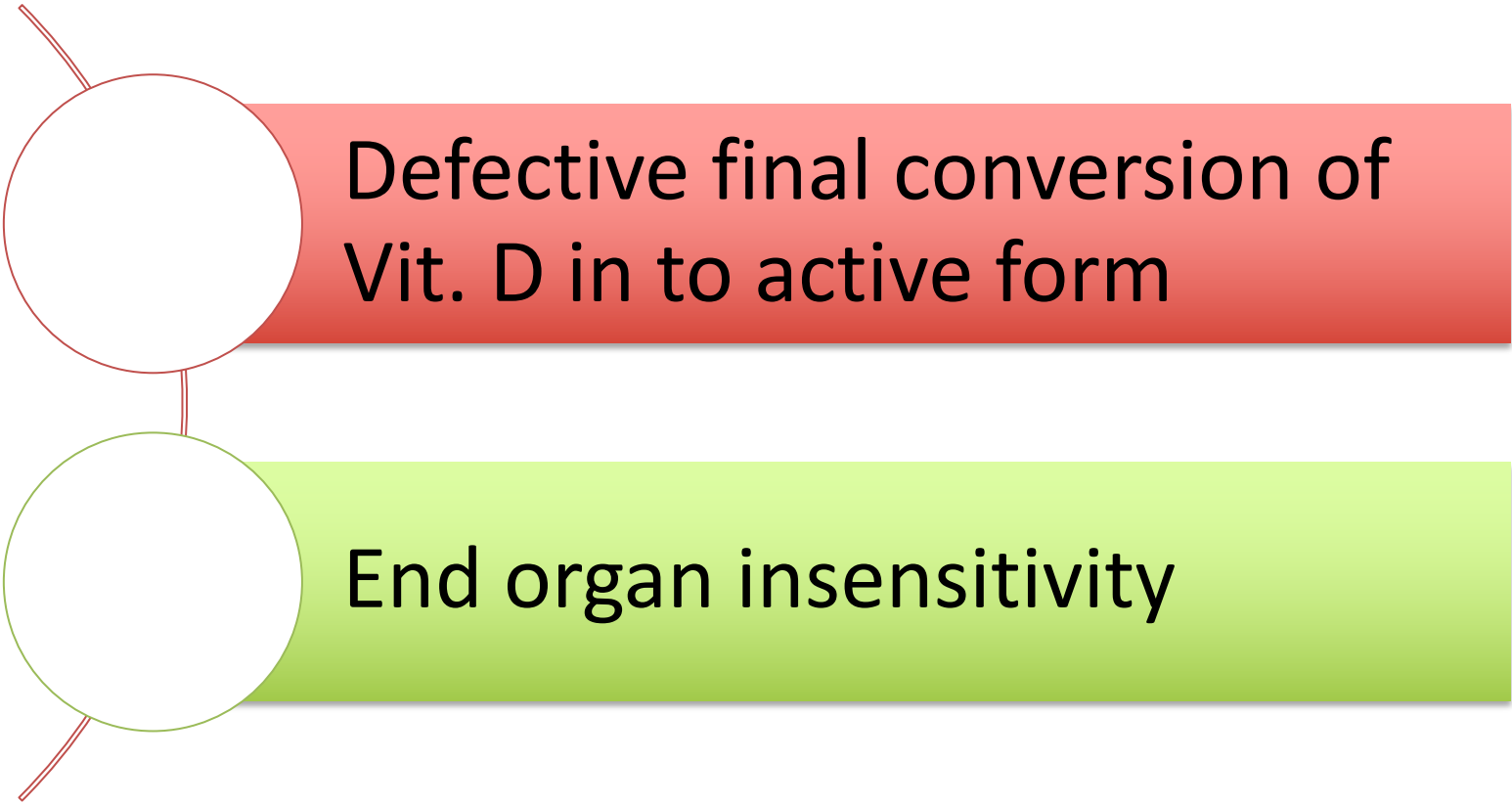
Investigations

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

0900

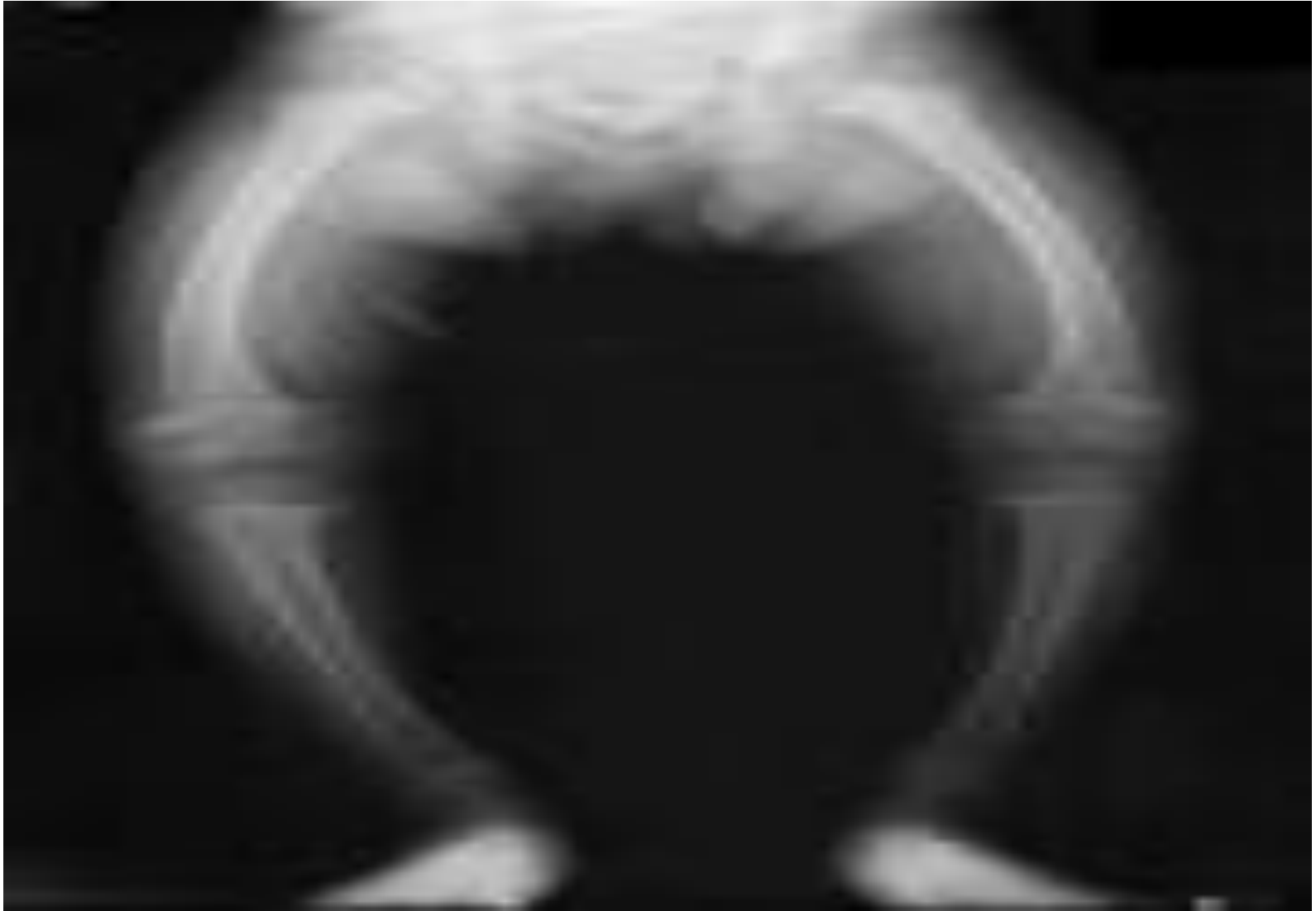


Vitamin D Resistant Rickets



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



