University of Ajdabiya
faculty of medicine
Department of Pediatrics

Seminar

Child With Pallor

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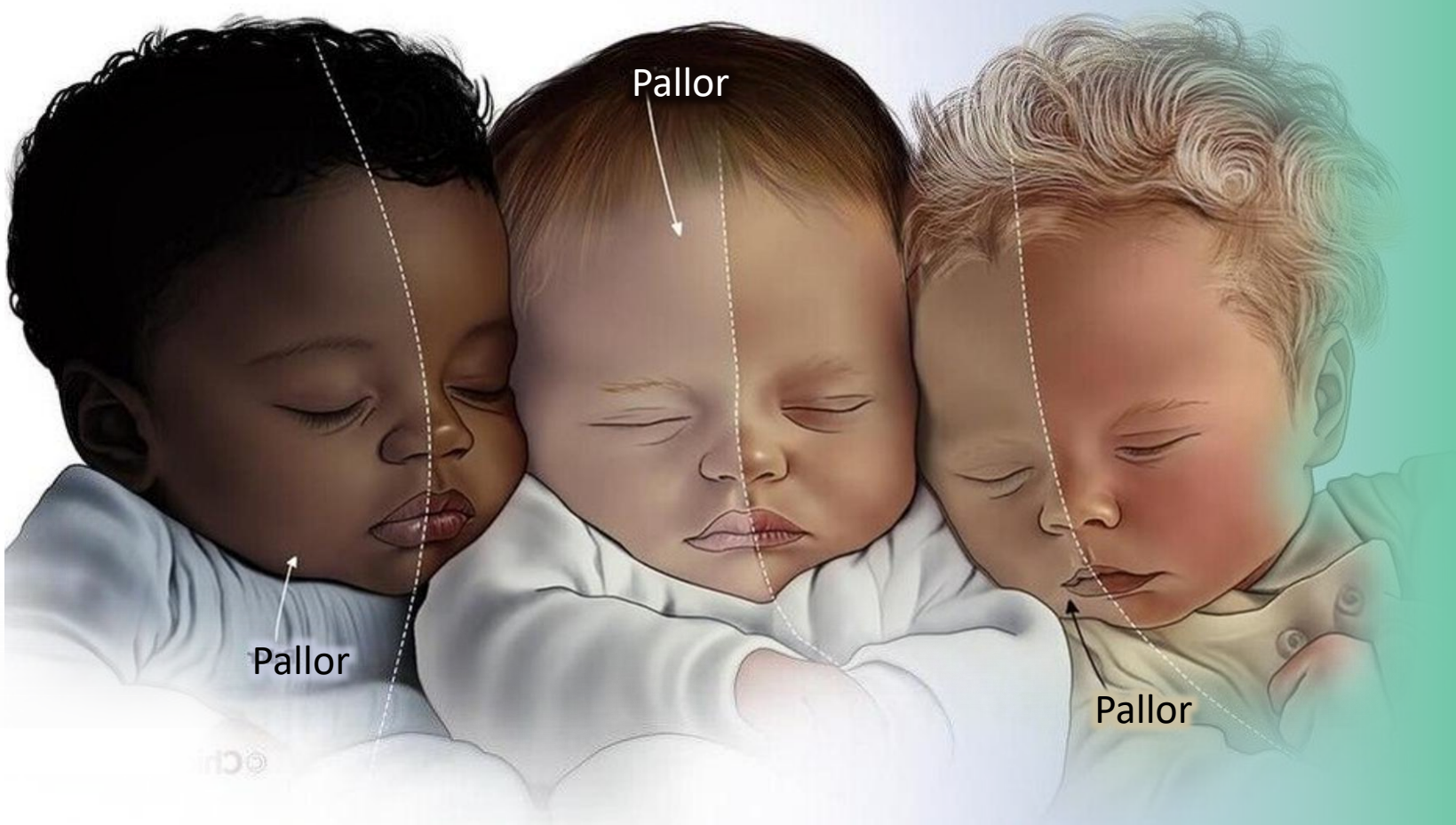


INTRODUCTION

- Pallor is a common clinical sign encountered in children and may be the first indication of an underlying systemic condition.
- Although often associated with anemia, pallor can result from non-hematological causes.
- Recognizing pallor requires differentiating between benign physiological variants and life-threatening hematological, malignant, or systemic disorders.
- Pallor is a clinical sign rather than a diagnosis itself.

Definition of pallor

“

Pallor is an abnormal whitening or loss of the normal pink color of the skin and mucous membranes.

”

Factors affecting the pallor:

1. Oxyhemoglobin status
2. Cutaneous microvasculature
3. Thickness of epidermis / melanin pigment

Learning Objectives:

1. Define pallor and understand its clinical significance in children.
2. Differentiate between pallor associated with anemia and pallor due to non-anemic causes
3. Apply a systematic approach to the evaluation of a child with pallor, including history, examination, and investigations.
4. Discuss the basic principles of management and emergency care of children presenting with pallor.

CLINICAL CASE

Patient

A 2-year-old child was brought to you in the clinic by his mother.

History (as reported by the mother)

She told you she noticed that he looks pale for 2 months and less active than before, Easy fatigability and decreased activity and Poor dietary intake with high milk consumption.

Examination

- Pale conjunctiva

- Mild tachycardia

Discussion

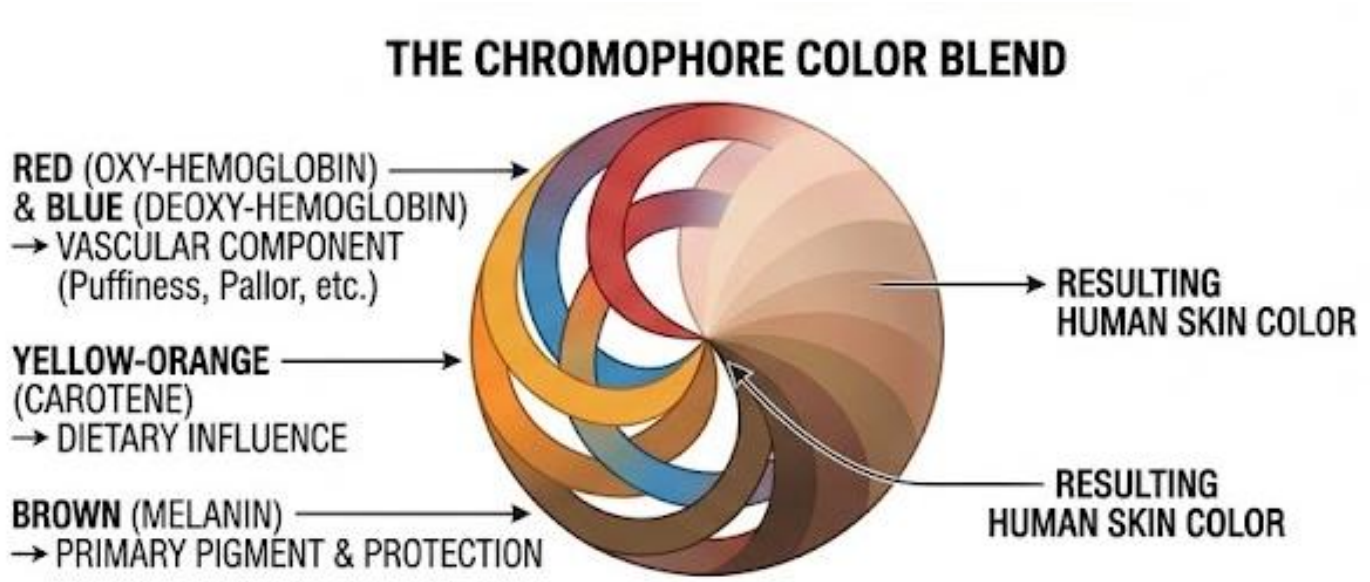
1. What does this finding suggest?
2. What are the possible causes?
3. What investigations are needed?

PART 1

Pathophysiology of Pallor and How To Confirm Pallor

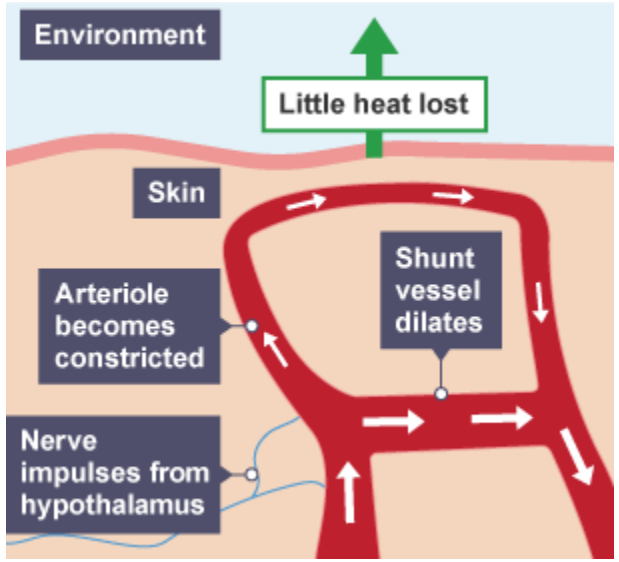
Physiology of skin color

- Skin color is a blend resulting from the skin chromophores **red** (oxy-hemoglobin), **blue** (deoxy-hemoglobin), **yellow-orange** (carotene) and **brown** (melanin).



https://www.sciencedirect.com/science/article/abs/pii/S0151963812701230

Mechanism of pallor

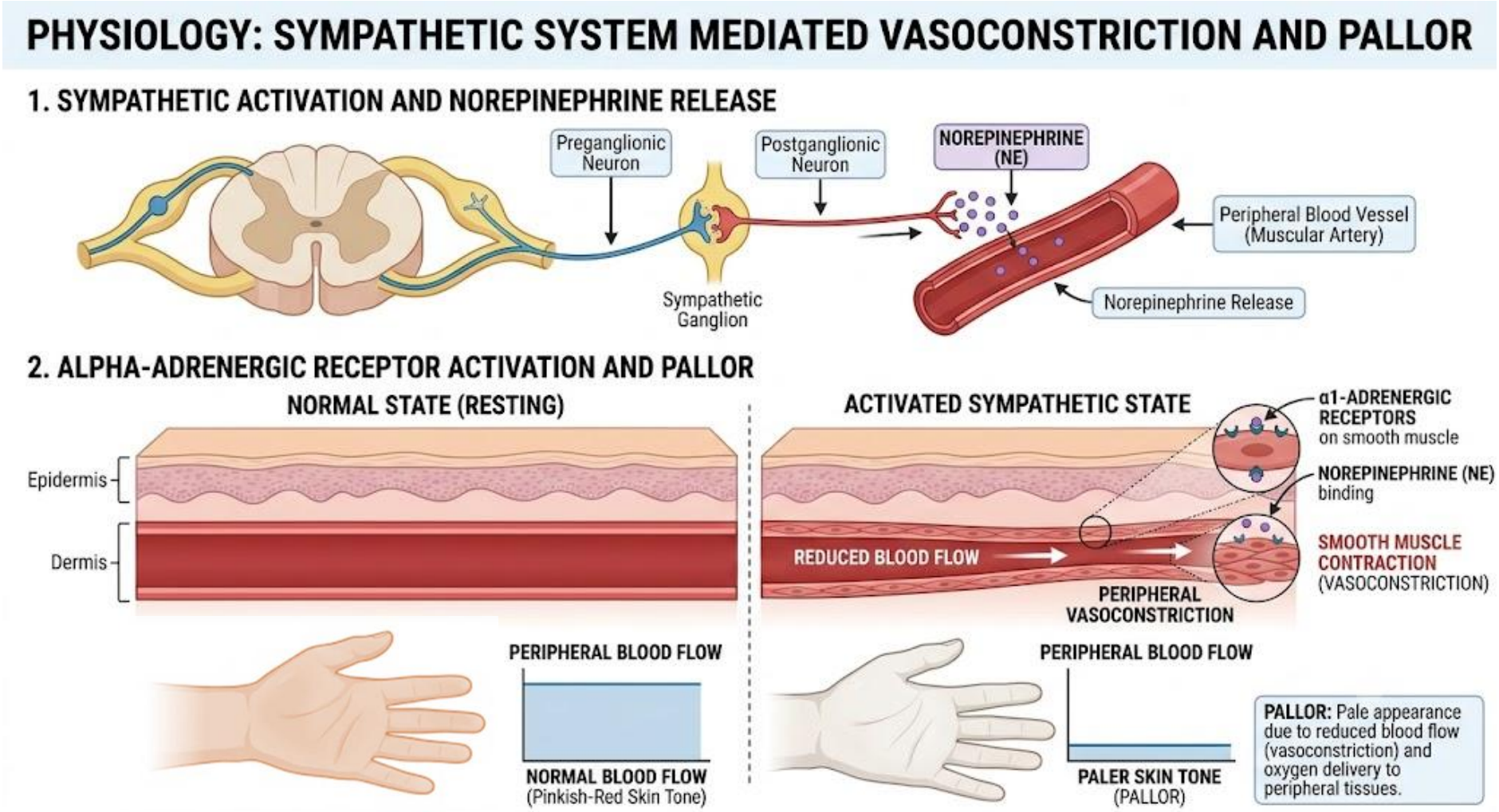


- Pallor develops through two mechanisms:
  - Decrease in hemoglobin mass (anemic pallor)

    A quantitative reduction in circulating red blood cells or hemoglobin concentration
  - Cutaneous vasoconstriction (vasomotor pallor)
    - Cold exposure (to decrease heat loss)
    - Sympathetic activation (to increase the perfusion to the vital organs)

      - hypovolemia
      - shock
      - pain
      - anxiety
      - acute stress

Mechanism of pallor



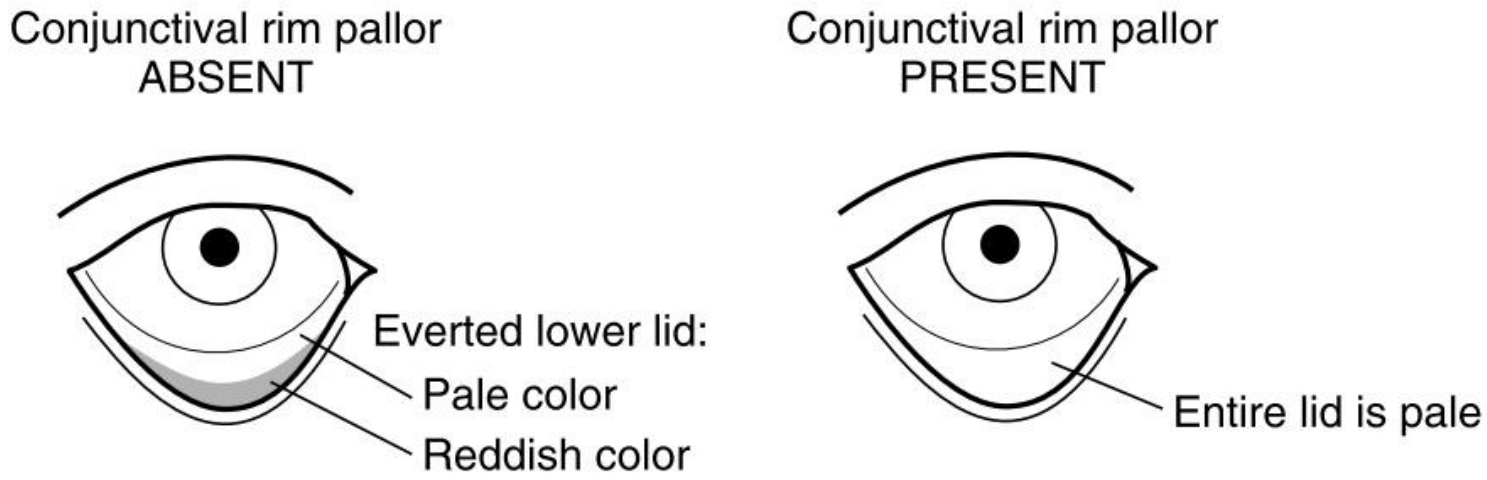
How to confirm true pallor?

To overcome assessment challenges like **ambient lighting**, **skin thickness**, and **ethnic pigmentation**, clinicians inspect specific anatomical sites (Areas with superficial capillaries & minimal melanin) like:

- Conjunctiva
- Tongue
- Palm
- Nailbed

How to confirm true pallor?

- **CONJUNCTIVA:** Classified as pale if the anterior rim of the lower palpebral conjunctiva appeared as pale as the deeper posterior rim.



Kalantri A and others. Accuracy and reliability of pallor for detecting anaemia: a hospital-based diagnostic accuracy study. PLoS One. 2010 Jan

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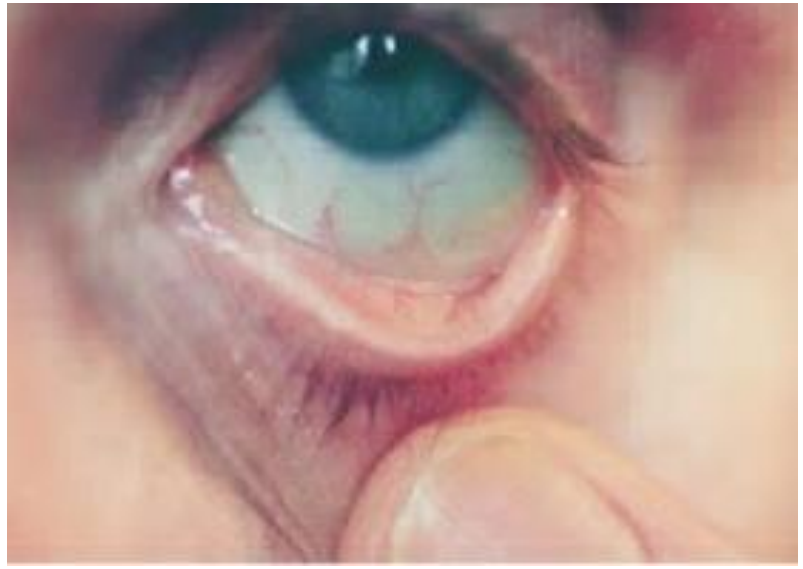

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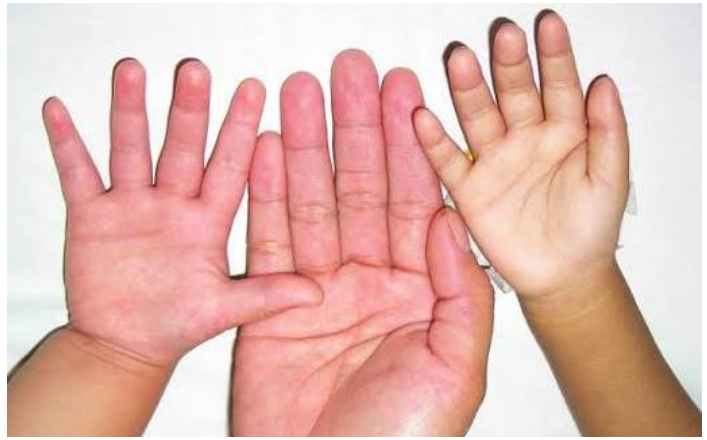
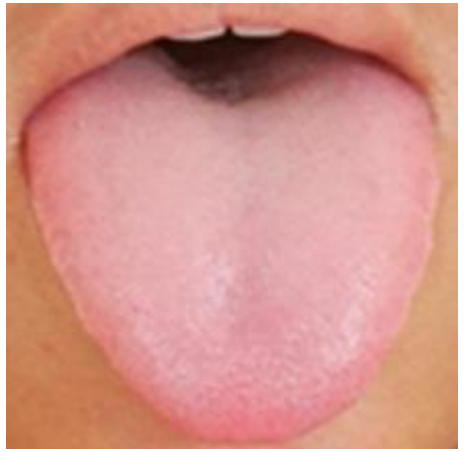
How to confirm true pallor?

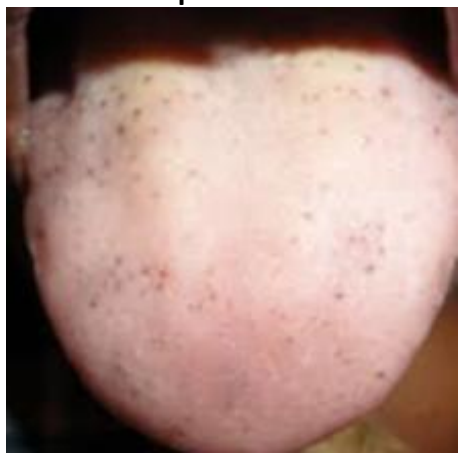
- **TONGUE:** Assessed by looking at the dorsum (top surface) of the tongue.
- **PALM:** Evaluated by examining the intensity of the color of the palmar creases.
- **NAILBED:** Assessed by observing the color of the fingernail.



Normal



pallor



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How to confirm true pallor?

Some local conditions that may obscure (mask) the pallor:

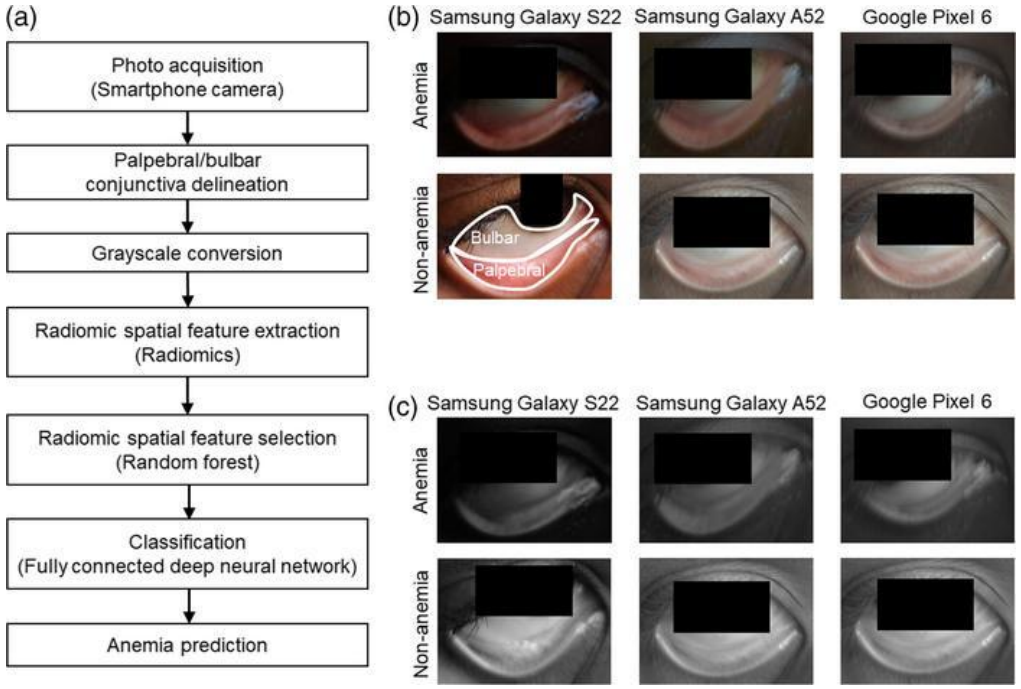
- Conjunctiva: Conjunctival infection/inflammation
- Palm: Vasodilation caused by some other disorder
- Tongue: oral thrush

- In any of these conditions, **#use_another_anatomical_site**

How to confirm true pallor?

New methods to detect pallor:

- Some applications can detect the pallor in the conjunctiva or palm by using the phone's camera
- This technology can be used as screening method for anemia in school aged children



Noninvasive method detects anemia in children by analyzing smartphone photos of the eye's conjunctiva

(15 Apr 2025) https://doi.org/10.1117/1.BIOS.2.2.022303

How to confirm true pallor?

New methods to detect pallor:

- Some products/tools can be used as a visual reference for the normal color of infant's tongue, which helps mothers detect anemia in their babies.

PART 2

Differential Diagnosis of Pallor

Differential Diagnosis of Pallor

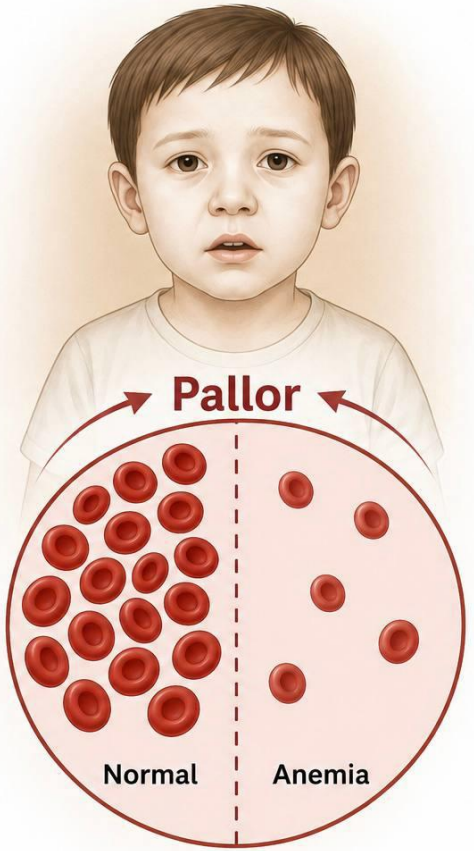
Pallor with anemia

Pallor without anemia

Pallor with anemia

1. Decreased red blood cell production

Occurs when the bone marrow cannot produce sufficient RBCs.



Pallor with anemia

1. Decreased red blood cell production

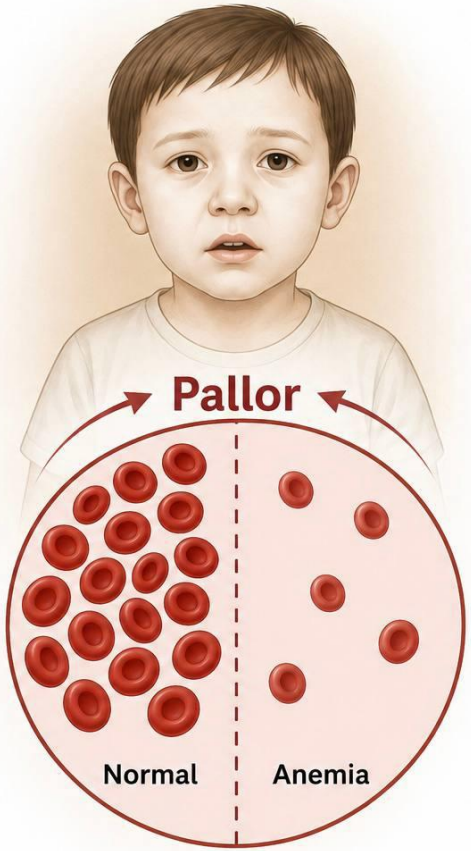
A. Nutritional Deficiency

B. Bone Marrow Failure

C. Bone Marrow Infiltration

D. Chronic Disease

E. Endocrine Disorders



Pallor with anemia

1. Decreased red blood cell production

A. Nutritional Deficiency

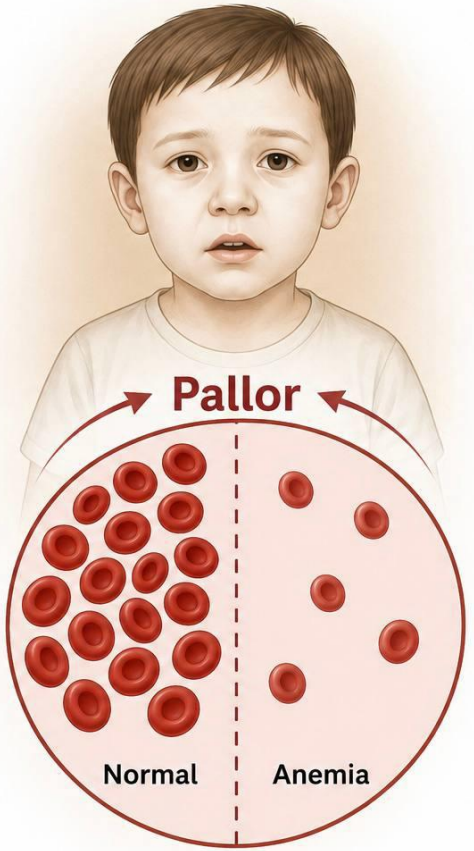
- Iron deficiency anemia (most common worldwide)
- Vitamin B12 deficiency
- Folate deficiency

B. Bone Marrow Failure

C. Bone Marrow Infiltration

D. Chronic Disease

E. Endocrine Disorders



Pallor with anemia

1. Decreased red blood cell production

A. Nutritional Deficiency

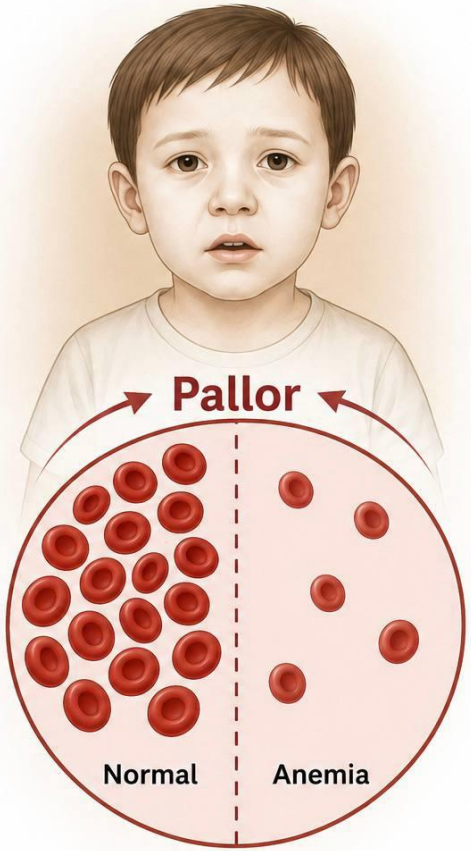
B. Bone Marrow Failure

- Aplastic anemia
- Fanconi anemia
- Diamond–Blackfan anemia

C. Bone Marrow Infiltration

D. Chronic Disease

E. Endocrine Disorders



Pallor with anemia

1. Decreased red blood cell production

A. Nutritional Deficiency

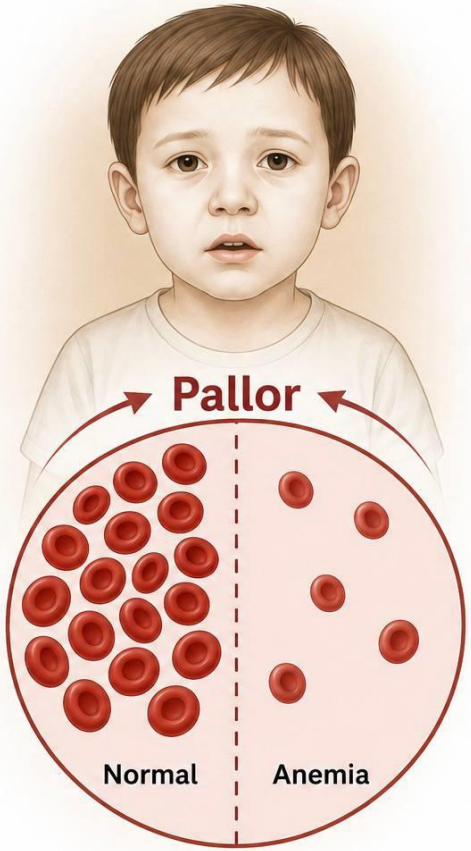
B. Bone Marrow Failure

C. Bone Marrow Infiltration

- Acute leukemia
- Lymphoma
- Neuroblastoma metastasis

D. Chronic Disease

E. Endocrine Disorders



Pallor with anemia

1. Decreased red blood cell production

A. Nutritional Deficiency

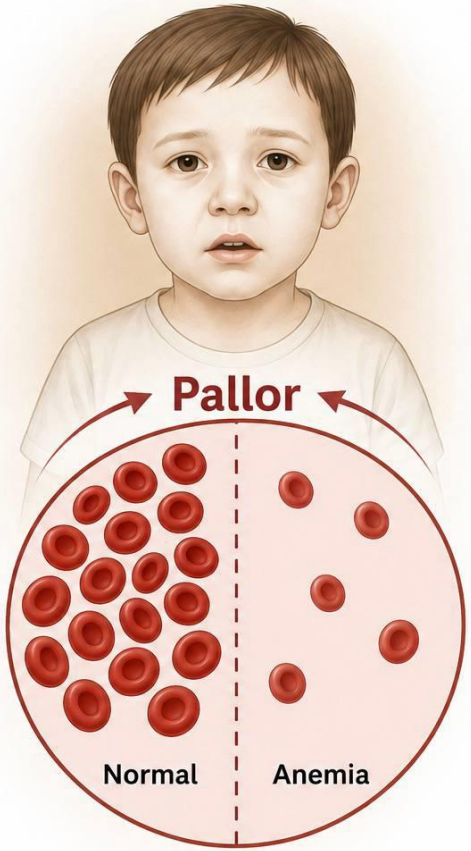
B. Bone Marrow Failure

C. Bone Marrow Infiltration

D. Chronic Disease

- Chronic kidney disease (↓ erythropoietin)
- Chronic inflammatory diseases
- Malignancy

E. Endocrine Disorders



Pallor with anemia

1. Decreased red blood cell production

A. Nutritional Deficiency

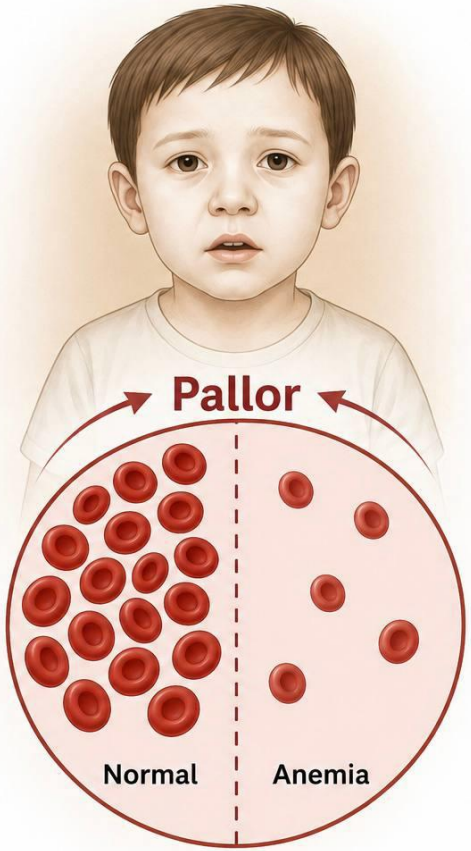
B. Bone Marrow Failure

C. Bone Marrow Infiltration

D. Chronic Disease

E. Endocrine Disorders

- Hypothyroidism
- Pituitary insufficiency (rare)



Pallor with anemia

2. Increased red blood cell destruction

A. Hereditary hemolytic disorders

- Hereditary spherocytosis
- G6PD deficiency
- Pyruvate kinase deficiency
- Sickle cell disease
- Thalassemia

B. Acquired hemolytic disorder

- Autoimmune hemolytic anemia
- Hemolytic uremic syndrome
- Disseminated intravascular coagulation
- Drug induced hemolysis
- Severe infection (e.g. malaria)

Pallor with anemia

3. Blood loss

A. Acute Blood Loss

- Trauma
- Surgery
- Gastrointestinal bleeding
- Epistaxis
- Intracranial hemorrhage (neonates)

B. Chronic Blood Loss

- Hookworm infestation
- Occult gastrointestinal bleeding
- Meckel diverticulum
- Inflammatory bowel disease
- Heavy menstrual bleeding in adolescents

Differential Diagnosis of Pallor

Pallor with anemia

Pallor without anemia

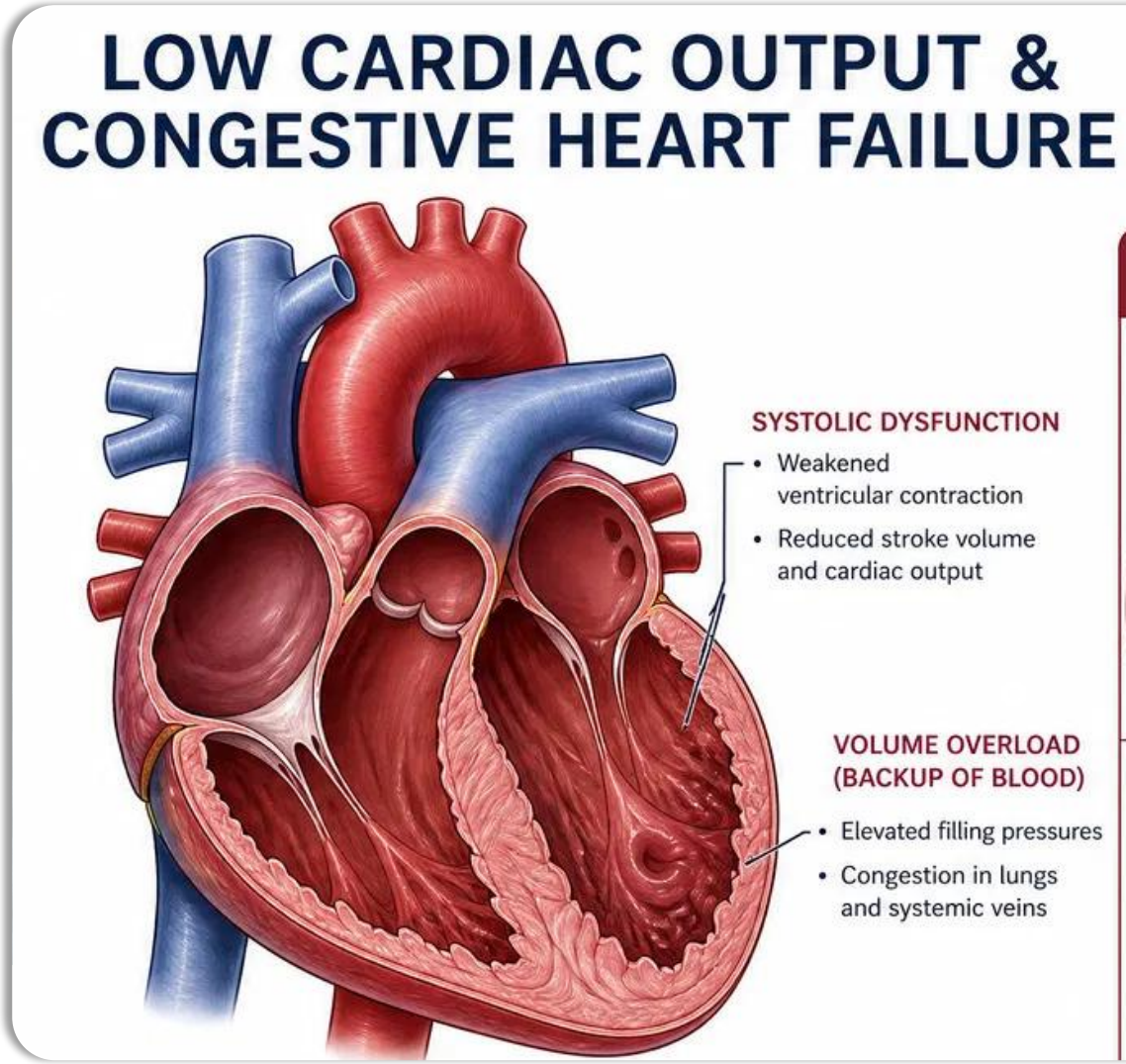
Pallor without anemia

1. **Peripheral Vasoconstriction**
   (The Most Common Cause)
   - Cold exposure
   - Hypovolemia
   - Fear or emotional stress

Pallor without anemia

2. Cardiovascular Disorders

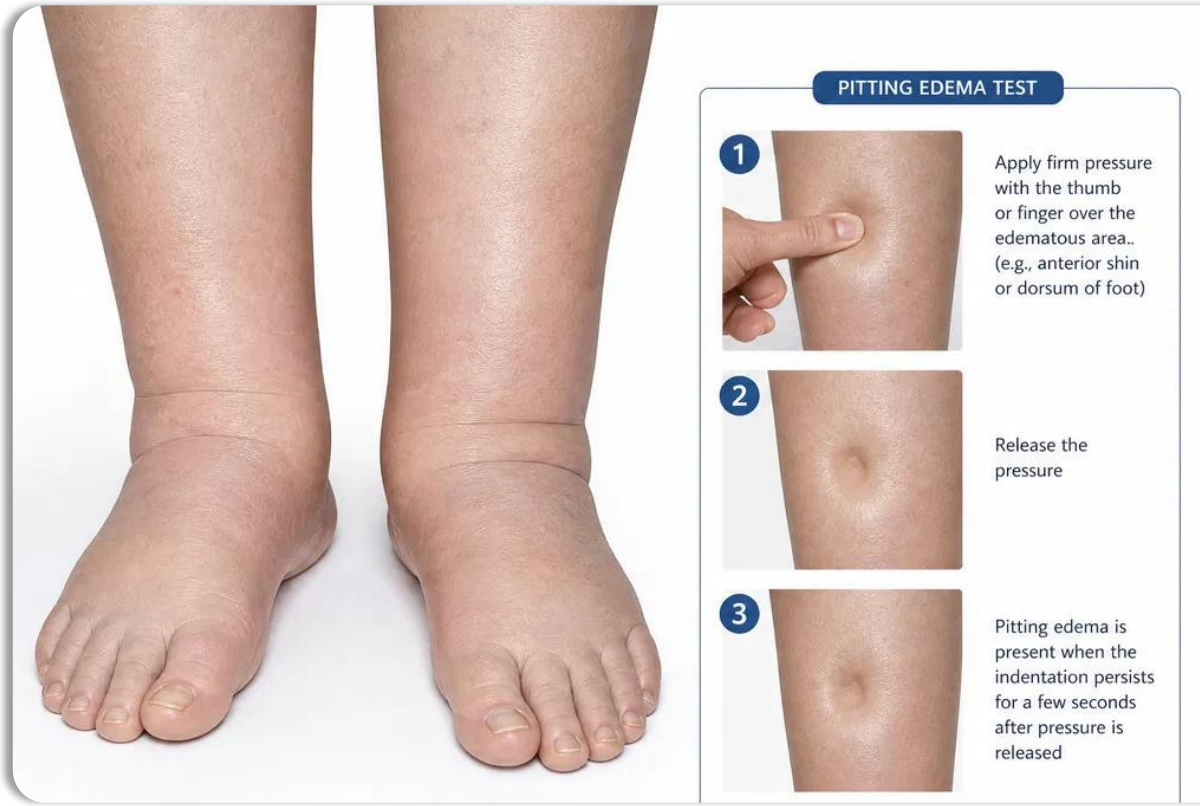
- Congestive heart failure
- Low cardiac output states
- Severe congenital heart disease



Pallor without anemia

3. Edematous States

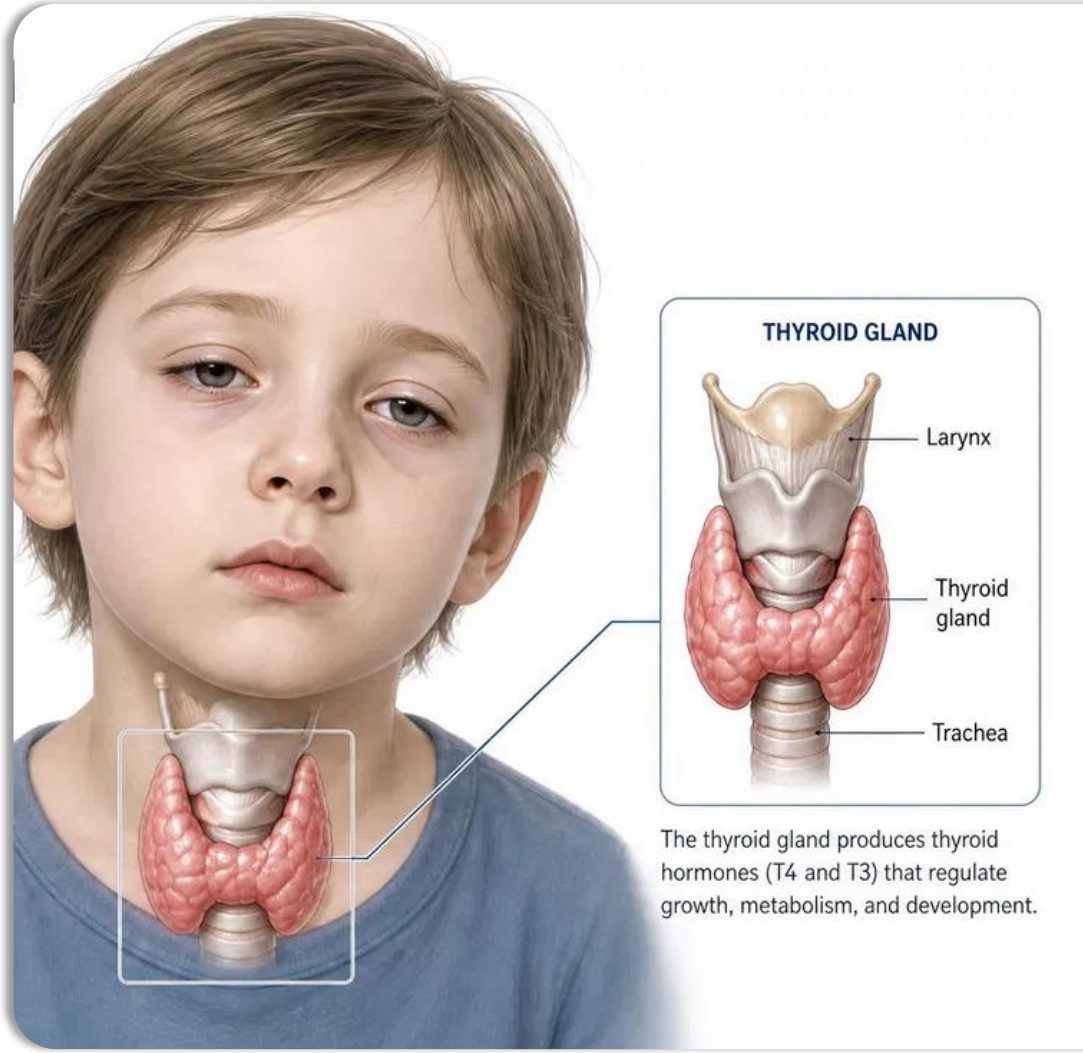
- Nephrotic syndrome
- Congestive heart failure
- Vasculitis with generalized edema



Pallor without anemia

4. Endocrine Disorders

- Hypothyroidism



Pallor without anemia

5. Constitutional (Physiological) Pallor

- Fair complexion
- Thin skin
- Familial pale appearance

Pallor without anemia

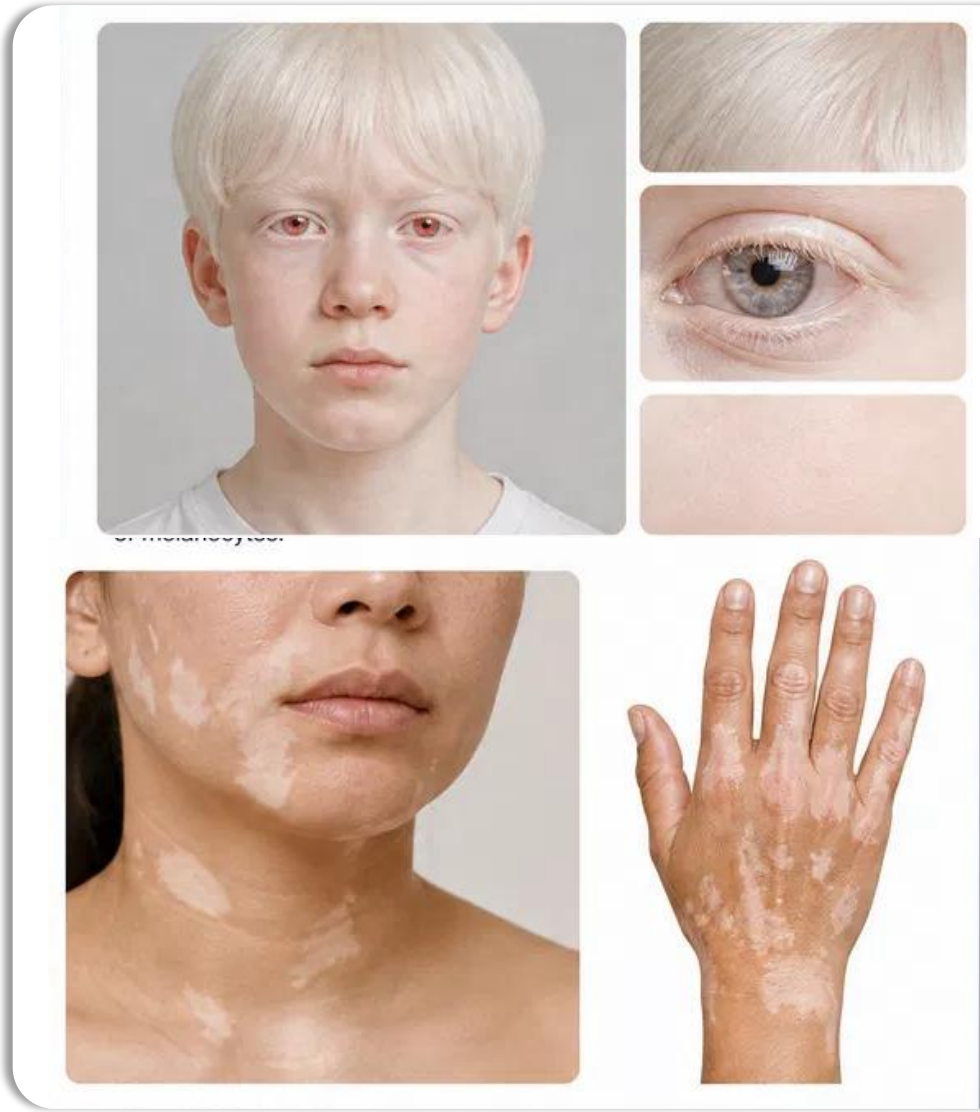
6. Chronic Illness Without Significant Anemia

- Chronic infections
- Post-inflammatory
- Chronic liver disease

Pallor without anemia

7. Disorders of Skin Pigmentation

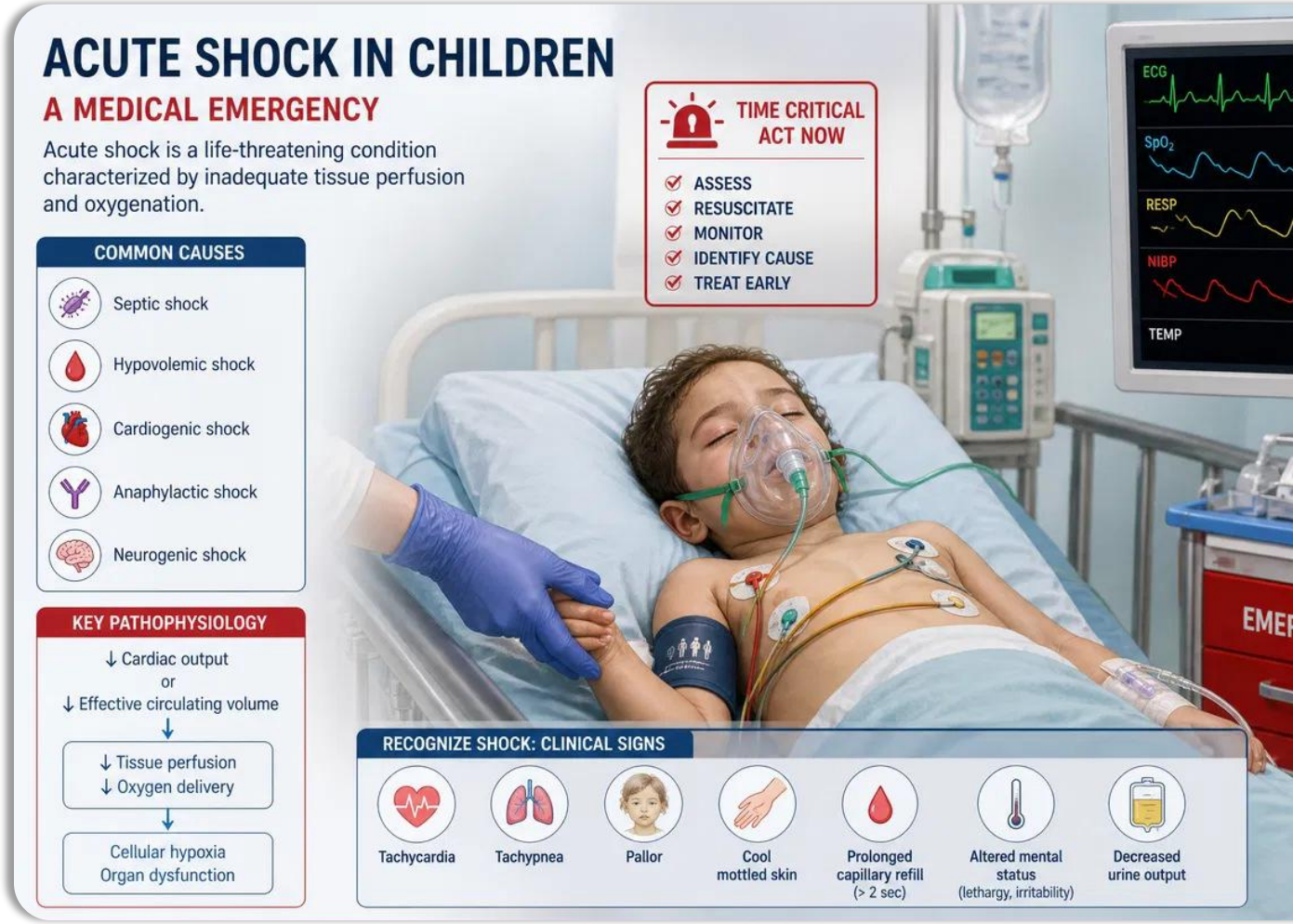
- Albinism
- Vitiligo
- hypopigmentation



Pallor without anemia

8. Acute Shock (pediatric Emergency)

- Septic shock
- Hypovolemic shock
- Cardiogenic shock



PART 3

Focused History Taking in a Child With Pallor

1. Demographic Data

Age & Sex Diagnostic Clues

- **Neonates:** Hemorrhage, Rh/ABO incompatibility, or severe congenital hemolytic anemias.
- **6-24 Months:** Peak incidence for Iron Deficiency Anemia (IDA) due to dietary transition.
- **Older Children:** Chronic disease, GI blood loss, acquired hemolysis, or malignancy.
- **Males:** X-linked recessive disorders (e.g., G6PD deficiency).
- **Adolescent Females:** Menorrhagia / Heavy menstrual bleeding.

2. Chief Complaint

> **"Paleness noticed by parents / caregiver"**

- **Key Question**: "When was the pallor first noticed, and has it been constant or progressive?“
- Establishing accurate duration distinguishes acute emergencies from insidious chronic conditions.

3. History of Present Illness (HPI)

A. Onset & Progression

- Sudden Onset: Suggests acute hemolysis (G6PD crisis, autoimmune AIHA) or acute hemorrhage.
- Gradual / Insidious Onset: Points toward nutritional deficiency, bone marrow failure, or chronic inflammation.

B. Functional Severity Assessment

- General Symptoms: Fatigue, lethargy, irritability, poor feeding, or poor suckling in infants.
- Cardiorespiratory Compromise: Shortness of breath, dyspnea on exertion, dizziness, lightheadedness, syncope, or palpitations.

4. Etiology-Driven Framework Overview

Category 1

Decreased RBC Production

- Nutritional Deficiencies (Iron, B12, Folate)
- Bone Marrow Failure (Aplastic)
- Bone Marrow Infiltration (Leukemia)
- Chronic Diseases (CKD, IBD)

4. Etiology-Driven Framework Overview

Category 2

Increased RBC Destruction

- Hereditary Hemolytic (G6PD, Sickle Cell, Thalassemia)
- Acquired Hemolytic (AIHA, HUS)
- Infections (Malaria, Sepsis)

4. Etiology-Driven Framework Overview

Category 3

Blood Loss

- Acute Blood Loss (Trauma, Birth)
- Chronic GI Loss (Melena, Parasites)
- Adolescent Menorrhagia

Category 1: Nutritional Deficiencies

Iron Deficiency Anemia (IDA)

- "Is the child consuming excessive cow's milk (> 500 mL/day or introduced before 1 year)?“
- "Is the child exclusively breastfed past 6 months without iron supplementation/fortified foods?“
- "Does the child exhibit Pica (craving non-food items like dirt, ice, paper, or clay)?“

Category 1: Nutritional Deficiencies

Vitamin B12 & Folate Deficiency

- "Does the child/mother follow a strict vegan diet without supplementation?“
- "Is there a history of chronic diarrhea, malabsorption, or intestinal surgery?"

Category 1: Bone Marrow Disorders

Bone Marrow Failure

- **Thrombocytopenia:** "Are there skin changes like petechiae, purpura, easy bruising, or gum/nose bleeding?“
- **Neutropenia:** "Is there a history of recurrent or severe infections/fevers?“
- **Congenital Anomalies:** "Were there skeletal defects noted at birth (e.g., thumb or hand anomalies)?"

Category 1: Bone Marrow Disorders

Bone Marrow Infiltration

Leukemia, Lymphoma, Neuroblastoma

- **Bone Pain:** "Does the child complain of persistent bone/joint pain that wakes them at night?“
- **Lymphadenopathy:** "Have you noticed painless lumps or swollen lymph nodes in the neck, armpits, or groin?“
- **Constitutional Signs:** Unexplained prolonged fever, night sweats, or weight loss.

Category 1: Chronic Diseases

Renal Pathology (CKD):

- "Is there a known history of kidney disease, facial swelling, or changes in urine output?“

Chronic Inflammation (IBD/Rheumatic):

- "Are there signs of chronic inflammation like persistent abdominal pain, chronic diarrhea, or joint swelling?“

Endocrine Disorders (Hypothyroidism):

- "Are there hypothyroid symptoms: severe constipation, dry skin, coarse hair, or growth delay?"

Category 2: Hereditary Hemolytic Anemias

G6PD Deficiency

- "Did the child recently ingest fava beans?"
- "Was there exposure to oxidative drugs (sulfonamides) or mothballs?"
- "Did you notice dark red, brownish, or tea-colored urine?“

Sickle Cell Disease

- "Does the child suffer from severe acute painful episodes in bones or abdomen?"
- "Has there been dactylitis (painful swollen hands/feet)?“

Thalassemia & Spherocytosis

- "Has the child experienced yellowish discoloration of eyes/skin (Jaundice)?"
- "Is there a family history of early gallstones or early splenectomy?"

Category 2: Acquired Hemolytic Disorders

Immune & Microangiopathic Hemolysis

HUS Clue: "Was there a recent viral/bacterial infection or an episode of bloody diarrhea?"
Drug-Induced (AIHA): "Has the child started any new medications recently?“

Infectious & Endemic Exposure

Malaria Risk: "Has the child traveled to or lived in a malaria-endemic region?"
Systemic Infection: Signs of sepsis, prolonged fever, or hemodynamic instability.

Category 3: Blood Loss Assessment

Acute Blood Loss

- "Is there a history of recent trauma, surgical procedures, or acute visible bleeding?"
- **Neonates:** "Was there birth trauma, fetal-maternal hemorrhage, or umbilical cord bleeding?“

Chronic Blood Loss

Gastrointestinal: "Is stool black/tarry (Melena) or containing bright red blood (Hematochezia)?"
Parasitic: "Does the child walk barefoot on dirt/soil?" (Risk of Hookworm infestation)
Adolescents: "Are menses unusually heavy (>7 days) or containing large clots?"

Past Medical History

Perinatal: Prematurity, low birth weight (depleted iron stores), neonatal jaundice/phototherapy.

Prior Episodes: Recurrent anemia, transfusions.

Drug & Exposure

Meds: NSAIDs/steroids (GI bleeding), oxidative drugs (G6PD hemolysis).

Environment: Lead paint pica or heavy metal exposure.

Family History

Genetics: Thalassemia, Sickle Cell, G6PD, Spherocytosis.

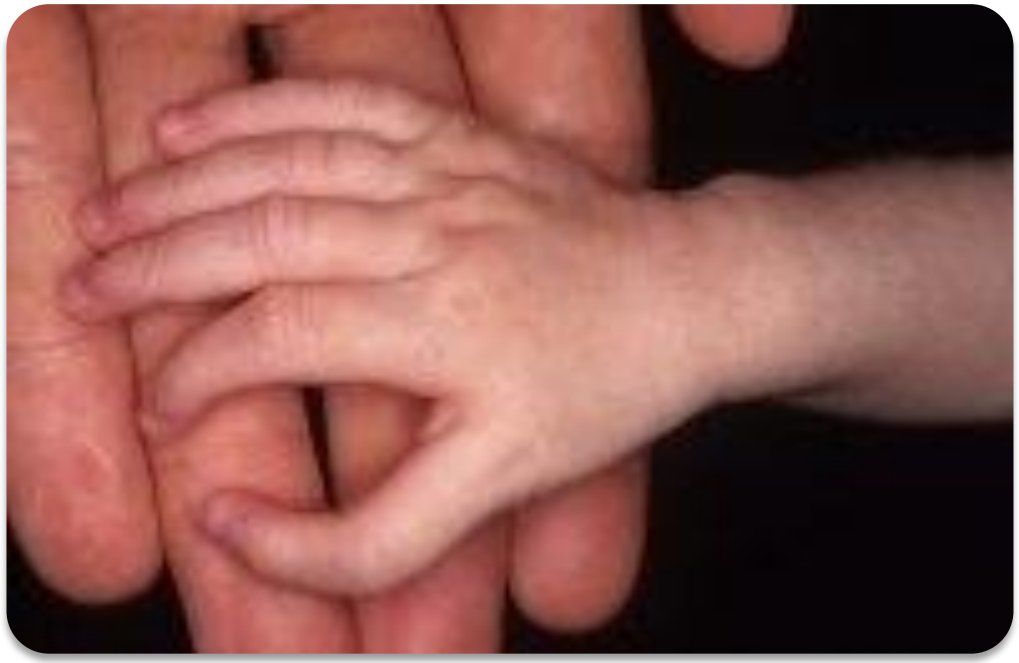
Consanguinity: Parental relation (autosomal recessive conditions).

PART 4

Physical Examination

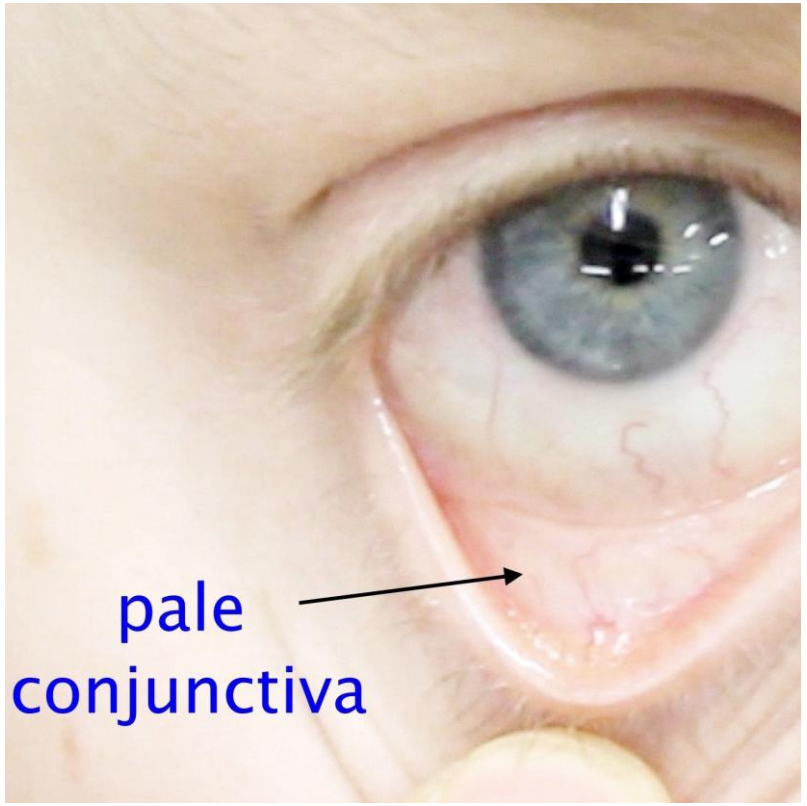
General Look & Appearance

- **Overall Status:** Alertness / Lethargy
- **Respiratory Distress:** Effort / Recessions
- **Dysmorphic Features:** Congenital facies (Fanconi / Diamond-Blackfan)



Head & HEENT

- **Eyes & Conjunctivae:** Conjunctival pallor / Scleral icterus / Retinal hemorrhages
- **Ears & Nose:** Epistaxis / Mucosal pallor
- **Oral Cavity:** Atrophic glossitis / Angular cheilitis / Bleeding gums
- **Skull & Facies:** Frontal bossing / Chipmunk facies (Thalassemia)



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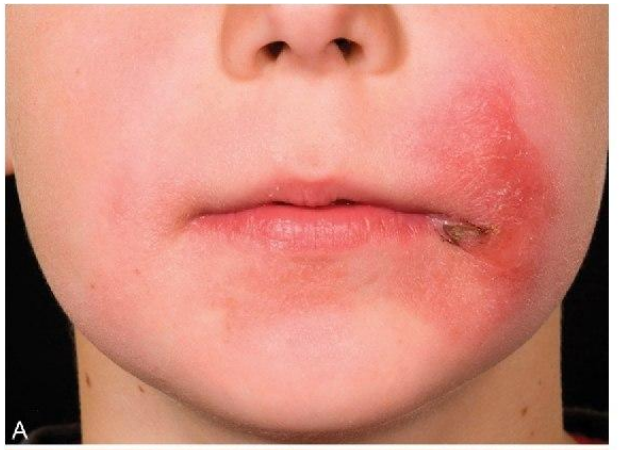

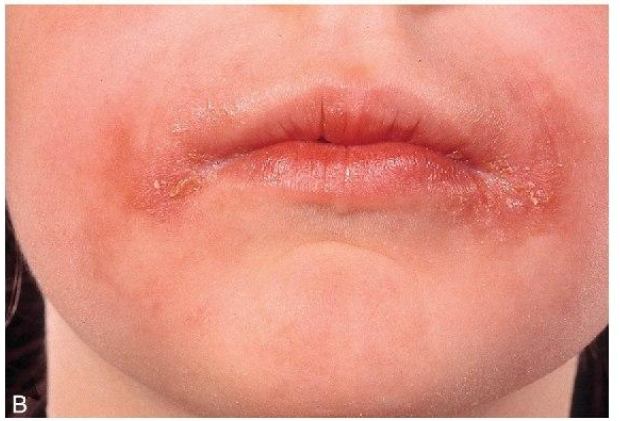

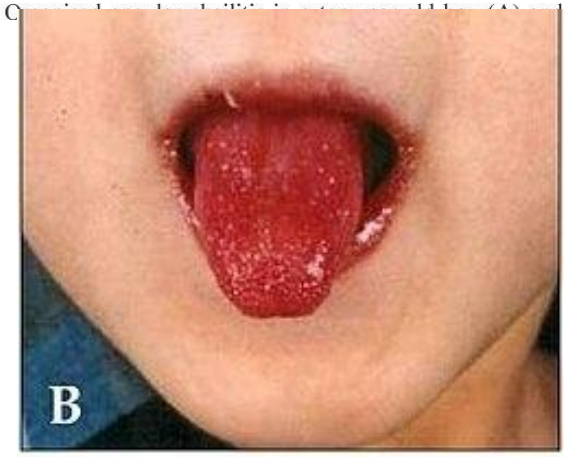

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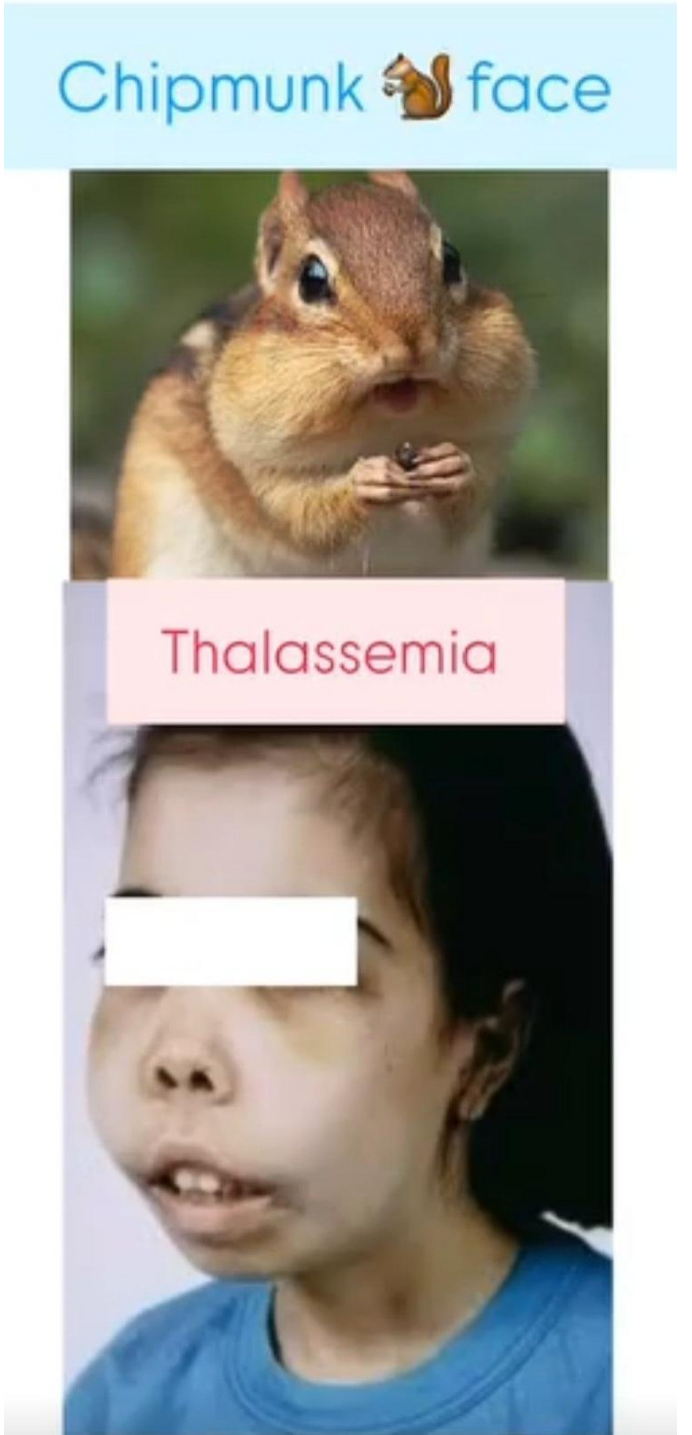
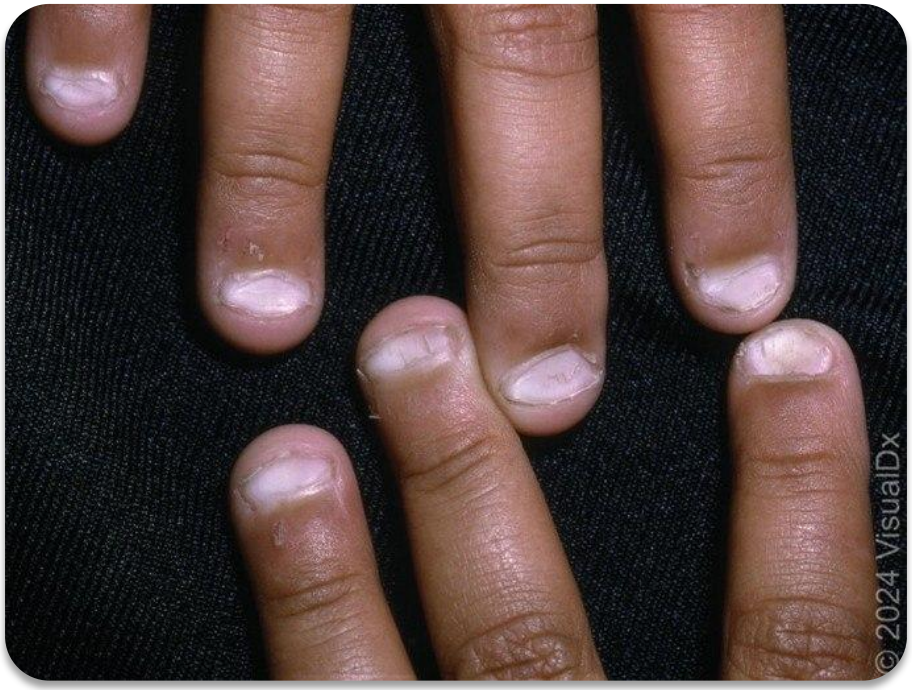


Skin & Appendages

- **Pallor & Jaundice:** Palms / Soles / Creases
- **Bleeding:** Petechiae / Purpura / Ecchymoses
- **Nails & Hair:** Koilonychia (Spoon nails) / Capillary refill / Brittle hair



Vital Signs

- **Pulse Rate & Rhythm:** Tachycardia (Compensatory / Shock)
- **Respiratory Rate:** Tachypnea (Hypoxia / Acidosis)
- **Blood Pressure:** Hypotension (Late shock) / Wide pulse pressure (Hyperdynamic)
- **Temperature:** Fever (Infection / Hemolysis / Malignancy)
- **Oxygen Saturation:** SpO2 (Oxygenation / Cardiopulmonary)

Growth Parameters

- **Plotting:** Height / Weight / Head circumference
- **Clinical Significance:** Failure to thrive / Growth stunting (Chronic disease / Malabsorption / Malnutrition)

Systemic examination

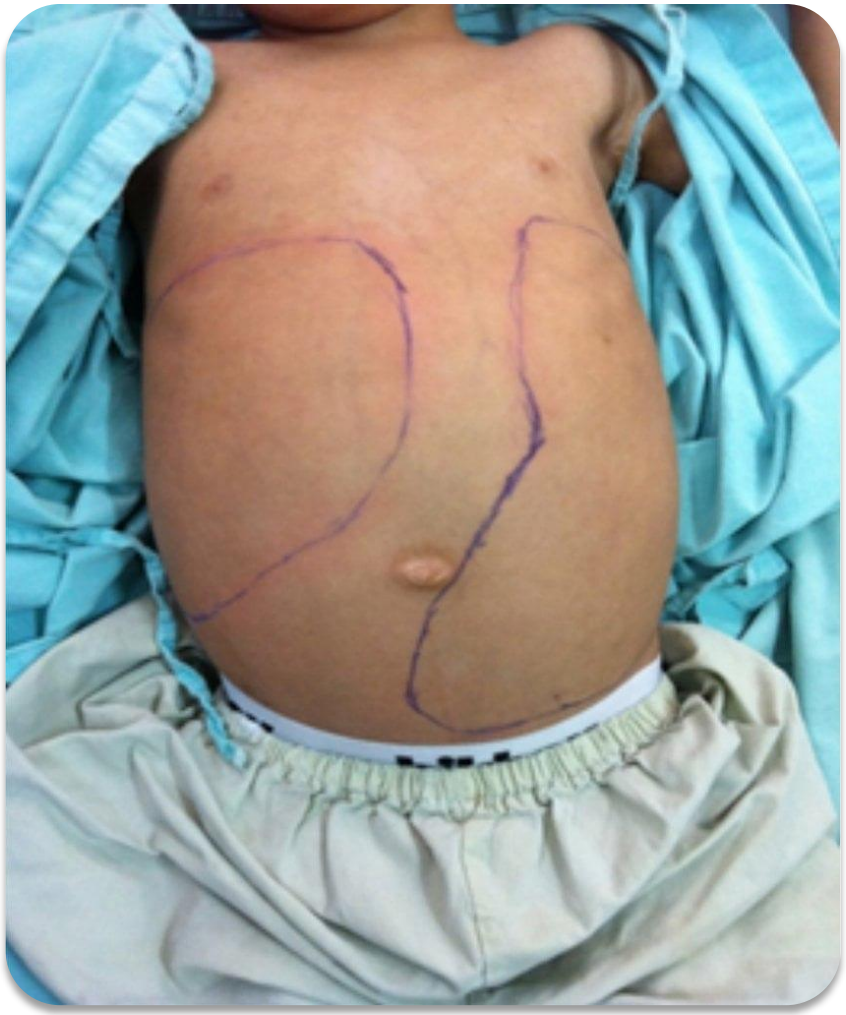
Cardiovascular system

- **Auscultation:** Systolic murmur (Flow murmur) / Hyperdynamic precordium
- **Heart Failure:** Gallop rhythm / Cardiomegaly

Abdomen

- **Splenomegaly:** Hemolysis / Portal hypertension / Storage diseases / Malignancy.
- **Hepatomegaly:** Extramedullary hematopoiesis / Heart failure / Infiltration

Systemic examination



Abdomen

- **Splenomegaly:** Hemolysis / Portal hypertension / Storage diseases / Malignancy.
- **Hepatomegaly:** Extramedullary hematopoiesis / Heart failure / Infiltration

Systemic examination

Musculoskeletal System

- **Bony Tenderness:** Marrow expansion / Leukemia
- **Joints & Extremities:** Arthritis (JIA) / Deformities (Absent radii) / Dactylitis (Sickle cell)

Lymphatic System

- **Lymphadenopathy:** Infection / Lymphoma / Leukemia

PART 5

Initial Diagnostic Approach and First-line Investigations

General Investigations

- Complete Blood Count (CBC)
- Peripheral Blood Film (PBF) and Reticulocyte Count
- Hemolytic Markers
- Renal Function Tests (RFT)

General Investigations

- Complete Blood Count (CBC)

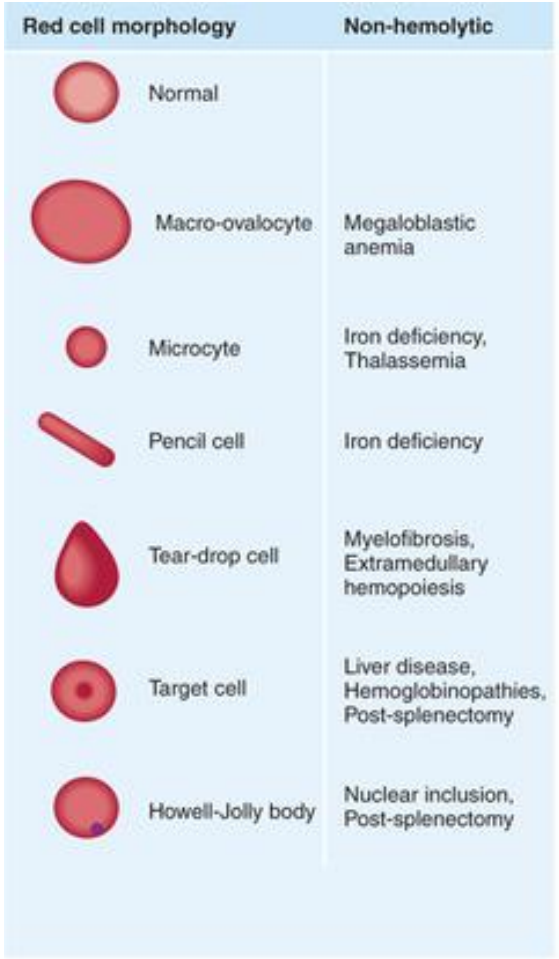
Hb	HCT	MCHC	WBC
▼	▼	▼	▼
Confirms anemia	Severity of anemia	↑ Hereditary spherocytosis	Aplastic anemia & Leukemia

Peripheral Blood Film (PBF) & Reticulocyte Count

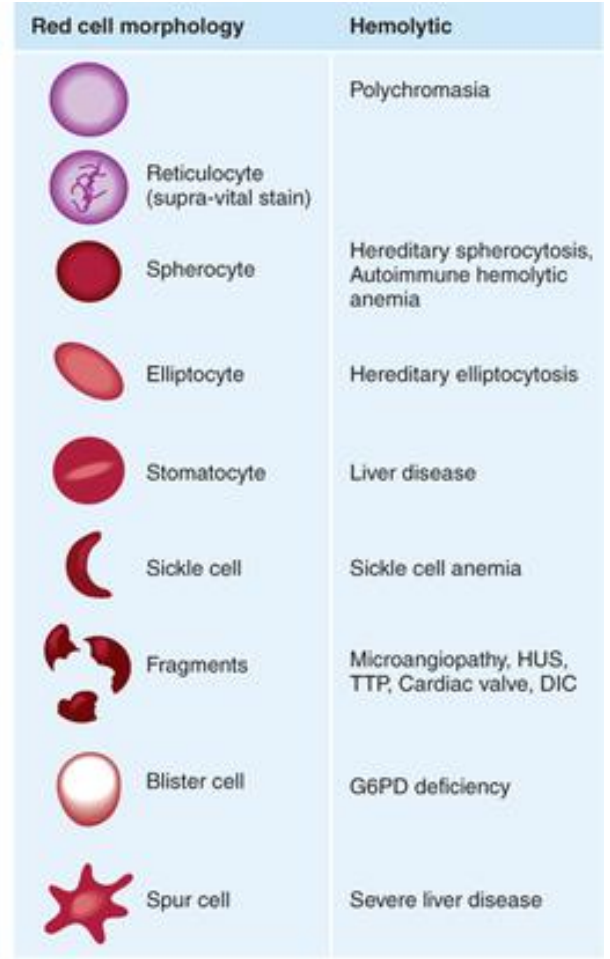
Peripheral Blood Film (PBF)

- Evaluates RBC morphology and size.
- Normal RBC size ≈ nucleus of a mature lymphocyte.
- Central pallor ≈ one-third of RBC diameter.

- **Increased Reticulocyte Count (Reticulocytosis)**
  - Indicates an active bone marrow response.
  - **Commonly seen in:**
    - Hemolytic anemia
    - Acute blood loss (hemorrhage)



Red cell morphology	Non-hemolytic
Normal	
Macro-ovalocyte	Megaloblastic anemia
Microcyte	Iron deficiency, Thalassemia
Pencil cell	Iron deficiency
Tear-drop cell	Myelofibrosis, Extramedullary hemopoiesis
Target cell	Liver disease, Hemoglobinopathies, Post-splenectomy
Howell-Jolly body	Nuclear inclusion, Post-splenectomy



Red cell morphology	Hemolytic
	Polychromasia
Reticulocyte (supra-vital stain)	
Spherocyte	Hereditary spherocytosis, Autoimmune hemolytic anemia
Elliptocyte	Hereditary elliptocytosis
Stomatocyte	Liver disease
Sickle cell	Sickle cell anemia
Fragments	Microangiopathy, HUS, TTP, Cardiac valve, DIC
Blister cell	G6PD deficiency
Spur cell	Severe liver disease

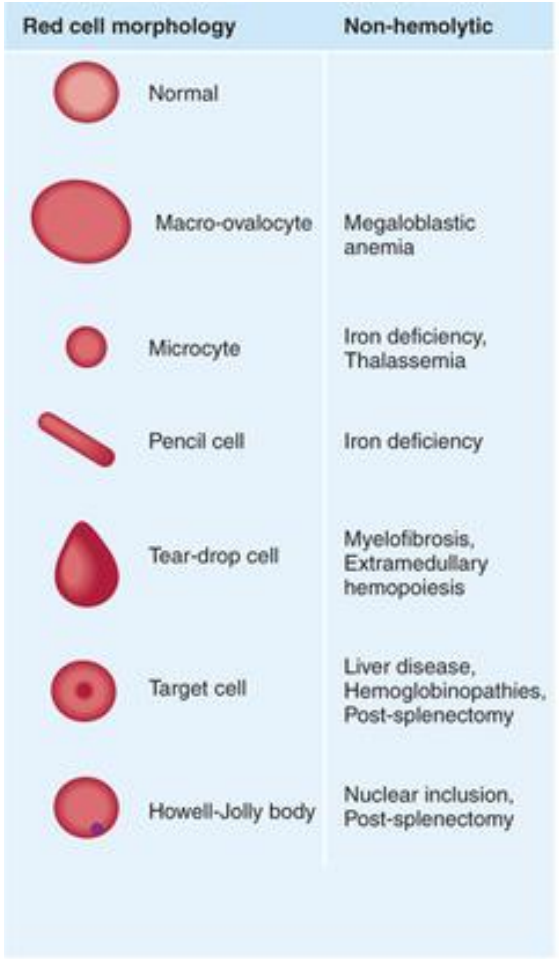
Peripheral Blood Film (PBF) & Reticulocyte Count

Decreased Reticulocyte Count (Reticulocytopenia)

Suggests reduced bone marrow production of RBCs.

Seen in:

- Aplastic crisis
- Bone marrow failure



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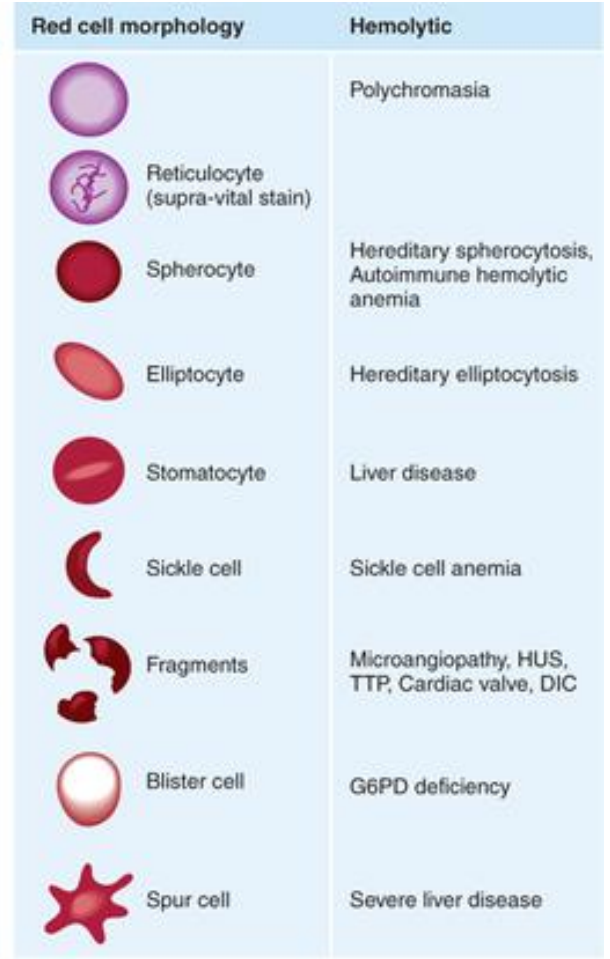

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Spur cell	Severe liver disease

PART 6

Classification of Anemia Based on MCV and Reticulocyte Count

What is MCV?

Mean Corpuscular Volume (MCV)is the average volume (size) of red blood cells (RBCs), measured in femtoliters (fL).

Normal Values: Children: 80–95 fL | Newborns: 96–108 fL

1. Microcytic anemia
(MCV < 80 fL)

- **Iron deficiency anemia** (most common)
- **Thalassemia |** Anemia of chronic disease
- **Lead poisoning |** Sideroblastic anemia (rare)

2. Normocytic anemia
(MCV 80–95 fL)

- **Acute blood loss |** Hemolytic anemia
- **Anemia of chronic disease |** Early iron deficiency
- **Aplastic anemia**

3. Macrocytic anemia
(MCV > 95 fL)

1. Megaloblastic
Vitamin B12 deficiency
Folate deficiency

2. Non-megaloblastic
Hypothyroidism
Liver disease
Bone marrow disorders
Reticulocytosis

Pure red cell aplasia:

Diamond Blackfan Anemia (DBA)

Congenital pure red cell aplasia

Presents in early infancy

Associated with macrocytosis & congenital anomalies (e.g., triphalangeal thumb)

Transient Erythroblastopenia of Childhood (TEC)

Acquired pure red cell aplasia

Usually occurs in toddlers

Typically normocytic or mildly macrocytic

Usually resolves spontaneously

Reticulocyte Count-Based anemia classification

What is a Reticulocyte?

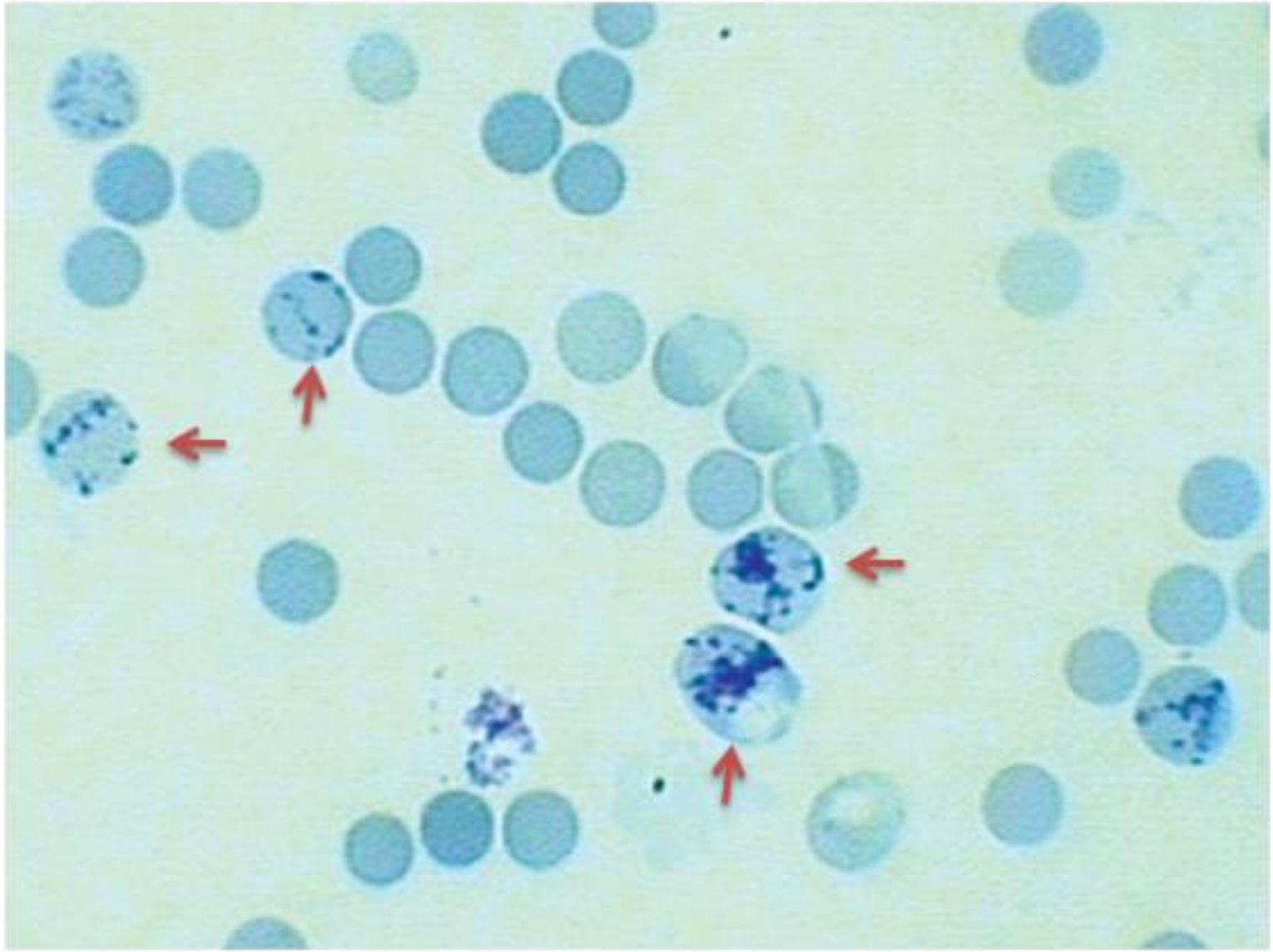
Reticulocytes are immature red blood cells (RBCs) recently released from the bone marrow into peripheral circulation.

Normal Reference Values

Children:0.5 –2.0% **Newborns:**2.0 –6.0%

Clinical Significance

The reticulocyte count directly reflects bone marrow erythropoietic activity and distinguishes production failure from RBC destruction or loss.



Hyporegenerative vs Regenerative

Hyporegenerative Anemia

Indicates inadequate bone marrow response due to decreased RBC production

- Iron deficiency anemia
- Vitamin B12 or folate deficiency
- Aplastic anemia / bone marrow failure
- Anemia of chronic disease
- Chronic kidney disease

Regenerative Anemia

Indicates an appropriate bone marrow response due to increased RBC loss or destruction

- Hemolytic anemia
- Acute blood loss
- Recovery after treatment of nutritional anemia

PART 7

Etiology-Specific Investigations

Etiology-Specific Investigations

Once first-line tests (CBC, indices, reticulocyte count, and peripheral smear) suggest a specific category of anemia, targeted investigations are ordered to confirm the exact etiology. These include:

- Iron studies
- Hemolysis workup
- Hemoglobin electrophoresis
- Bone marrow examination
- Renal investigations

Iron studies

Indication:

Ordered in microcytic, hypochromic anemia with low RPI. Helps differentiate Iron Deficiency Anemia (IDA) from Anemia of Chronic Disease (ACD) and thalassemia trait.

Typical findings in IDA:

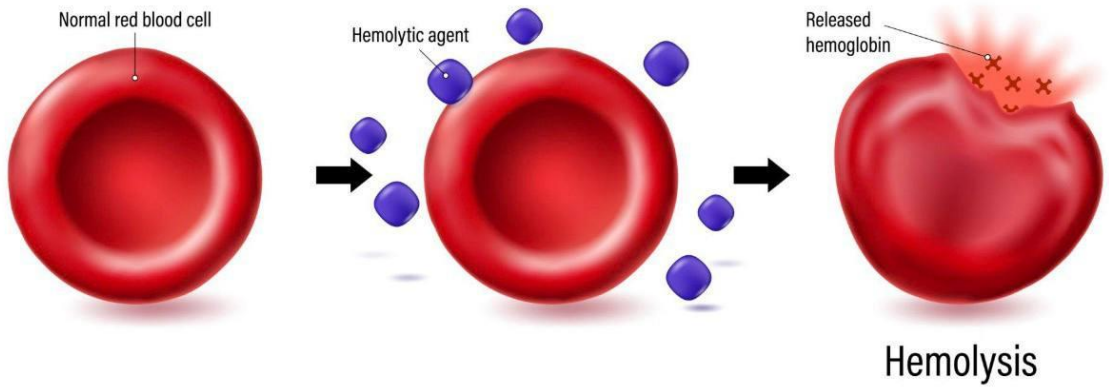
↓ Serum ferritin: Reflects decreased iron stores.
↓ Serum iron: Indicates reduced circulating iron.
↑ TIBC: Increased iron-binding capacity.
↓ Transferrin saturation: Reduced iron available for hemoglobin synthesis.

Note: Ferritin may be falsely elevated in inflammation (acute-phase reactant).

Hemolysis Workup

Indication:

Ordered in normocytic or macrocytic anemia with high reticulocyte count, or when hemolysis is suspected (jaundice, dark urine, splenomegaly).



1. General screening for hemolysis

↑ Serum LDH: Due to RBC destruction.

↑ Indirect bilirubin: Due to hemoglobin breakdown.

↓ Haptoglobin: Due to binding with free hemoglobin.

2. Tests to identify the cause of hemolysis

Direct Coombs test: Detects RBC antibodies/complement → Immune hemolytic anemia.

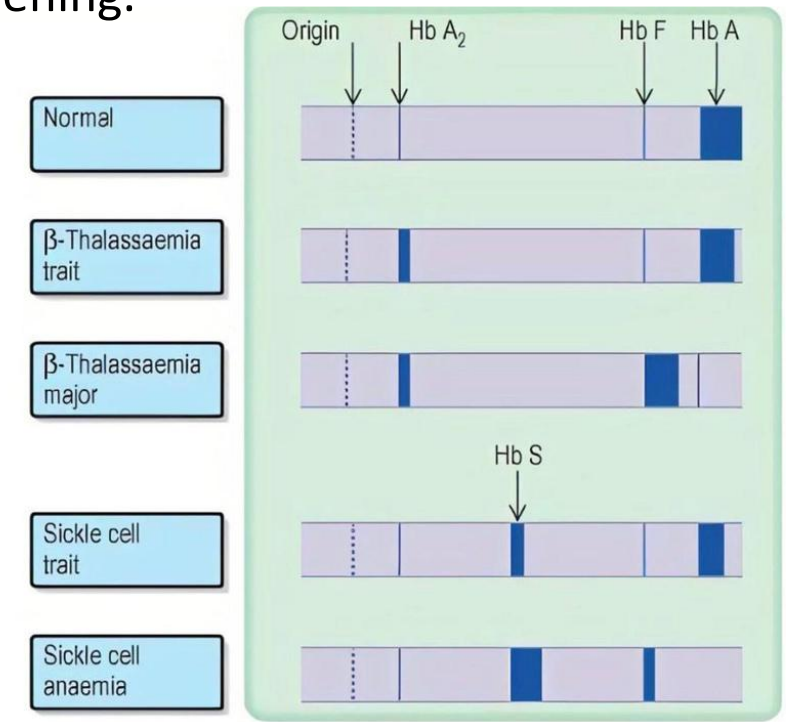
Red cell enzyme assay: Detects enzyme deficiencies (e.g., G6PD, pyruvate kinase).

Hereditary spherocytosis screening: EMA binding or osmotic fragility test detects RBC membrane defects.

Hemoglobin Electrophoresis

Indication:

Ordered when hemoglobinopathy is suspected (e.g., SCD or thalassemia) based on family history, ethnicity, microcytic anemia unresponsive to iron, or positive newborn screening.



Typical findings:

β-Thalassemia Trait: ↑ HbA_2 (>3.5%), ± slight ↑HbF.
β-Thalassemia Major: ↓ or absent HbA, HbF predominates (>90%).
Sickle Cell Disease (HbSS): Predominantly HbS (80–90%), ↑ HbF, absent HbA.

Normal (after 1 year):

HbA: >95%
HbA_2: 1.5–3.5%
HbF: <1–2%

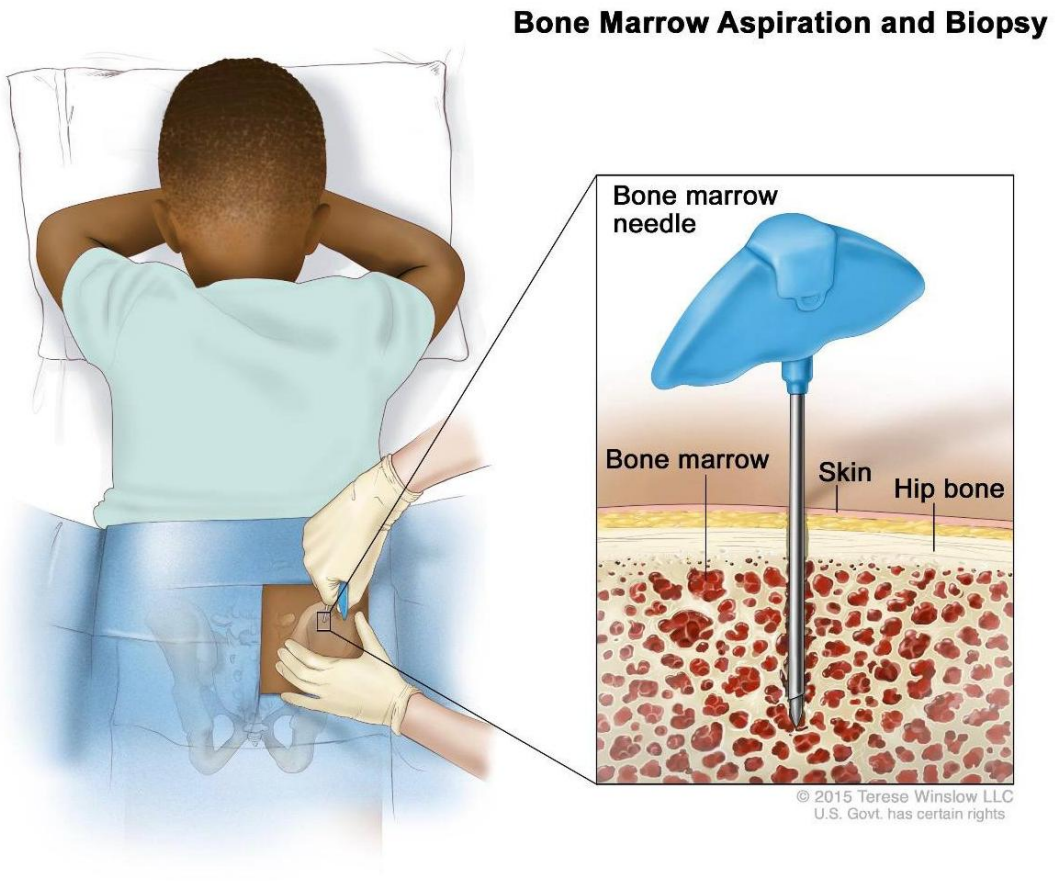
NOTE:

α-thalassemia trait is not reliably diagnosed by electrophoresis; genetic testing is required.

Bone Marrow Examination

Indication:

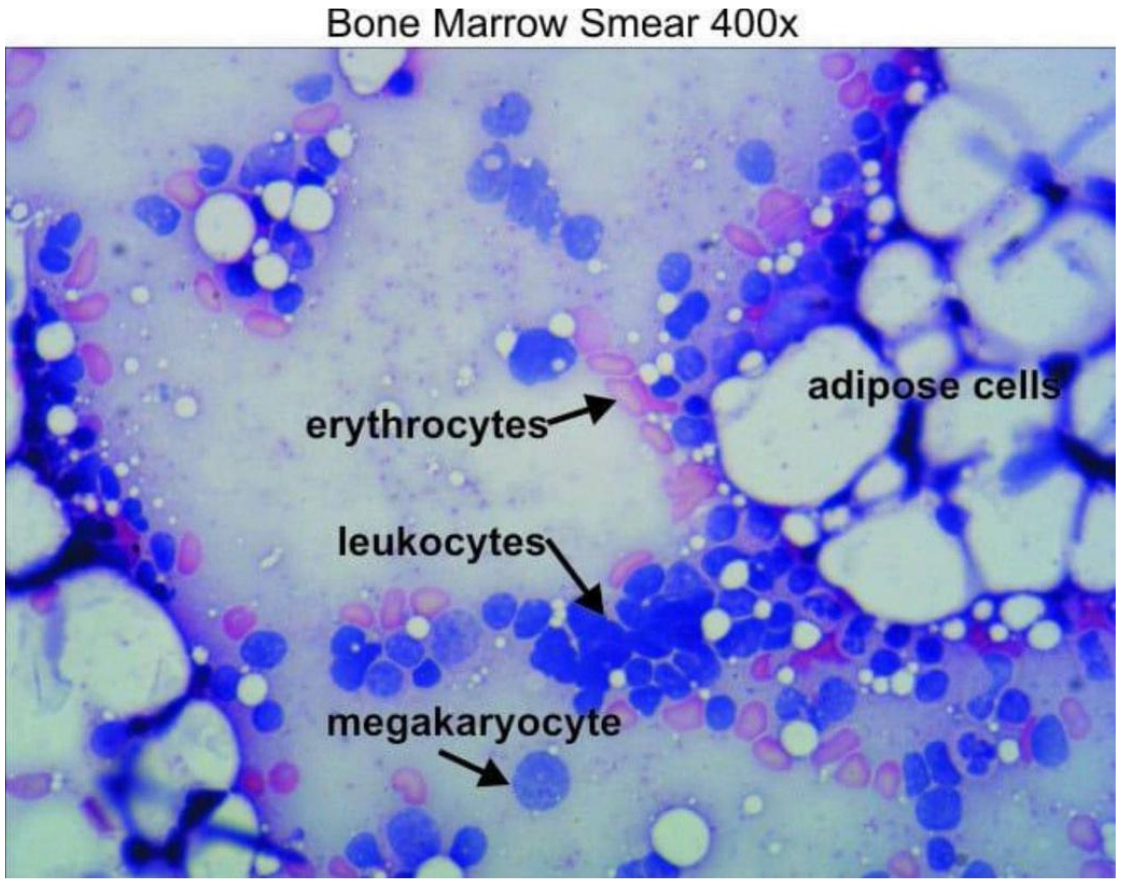
An invasive procedure reserved for red flags in children with anemia.



- ✓ **Pancytopenia / bicytopenia:** Anemia with low WBCs and/or platelets → suspect aplastic anemia or leukemia.
- ✓ **Abnormal peripheral smear:** Unexplained blasts or atypical cells.
- ✓ **Refractory anemia:** No response to appropriate therapy.
- ✓ Suspected marrow infiltration or storage disease (e.g., Gaucher disease).

What it evaluates:

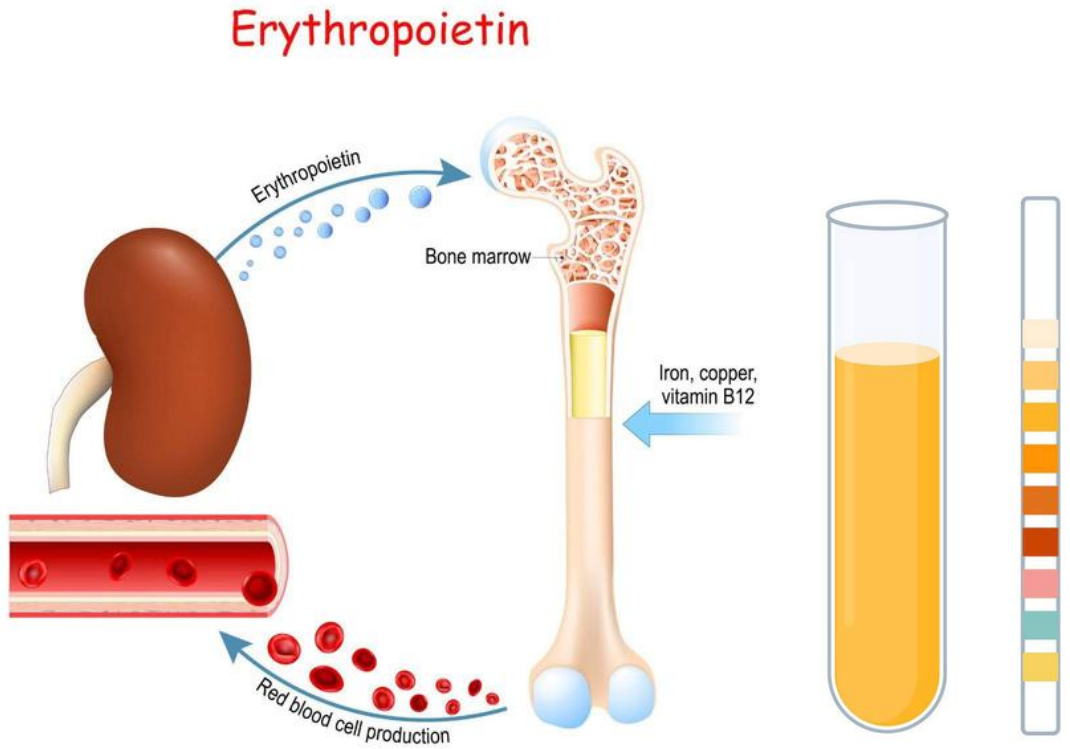
- Cellularity.
- Erythroid and myeloid maturation.
- Megakaryocytes.
- Abnormal infiltrates (e.g., blasts).



Findings:

- ✓ **↑ Erythroid precursors:** Increased RBC production response (seen in some hemolytic anemias).
- ✓ **↓ Erythroid activity:** Reduced RBC production (e.g., aplastic anemia, marrow suppression).
- ✓ **Abnormal cells or infiltration:** Suggests leukemia or malignancy.

Renal Investigations



Indication:

Considered in normocytic, normochromic anemia with low reticulocyte count, hypertension, edema, altered urine output, or suspected kidney disease.

Main investigations

1. Serum Creatinine & Blood Urea Nitrogen

Assess renal function.
↑ Creatinine / ↑ BUN → Impaired kidney function.

2. Estimated GFR (eGFR)

Measures kidney filtration capacity.
↓ eGFR → Reduced renal function.

3. Urinalysis

Proteinuria → Renal disease.
Hematuria → Possible renal pathology.

4. Erythropoietin (EPO) level (when indicated)

Produced by kidneys and stimulates RBC production.
CKD: ↓ EPO → ↓ RBC production → anemia.

PART 8

Management of the child with pallor

Core Principles of Clinical Management

Maintain Cardiorespiratory Stability

- Prioritize airway, breathing, and circulation (ABC).
- Ensure adequate tissue oxygenation and stabilize hemodynamics immediately in acute or severe distress.

Treat Infections Promptly

- Identify and manage co-existing bacterial, viral, or parasitic infections (e.g., malaria, sepsis) early.
- Prevents ongoing bone marrow suppression and further clinical deterioration.

Avoid Unnecessary Transfusions

- Adhere to restrictive transfusion protocols.
- Reserve red blood cell administration strictly for severe anemia accompanied by hemodynamic compromise or clinical shock.

Baseline Hematology Before Empiric Therapy

- Collect essential blood samples (FBC, reticulocyte count, peripheral blood film) prior to starting empiric iron or vitamin supplementation.
- Prevents masking the underlying diagnosis and ensures appropriate targeted treatment.

Clinical Management Algorithm Overview: Child Presenting with Pallor

1. Child Presenting with Pallor

(Perform focused history and general physical exam)

2. Triage & Mucosal Assessment

(Inspect conjunctiva, oral mucosa, and palmar creases)

(Inspect conjunctiva, oral mucosa, and palmar creases)

Branch A: Mucosa is PALE

A1. True Anemia
(Decreased Oxygen Delivery)

A2. Evaluate Complete Blood Count (CBC)

- Hemoglobin, Hematocrit
- Reticulocyte Count
- RBC Indices (MCV, MCH)
- Peripheral Smear Review

Branch B: Mucosa is PINK

B1. Pallor Without Anemia
(Normal Oxygen Content)

B2. Evaluate Perfusion, Vital Signs, Glucose

- Blood Pressure, Heart Rate
- Capillary Refill Time
- Serum Glucose, Thyroid, Renal Panel

Branch A: Management (Part I: Targeted)

- ***Initial***: O_2 therapy, rest
- ***Severe (Hb < 7 g/dL or symptomatic)***: Slow PRBC Transfusion with Diuretics (Prevent TACO/Volume
- ***Deficiency***: Iron, Vitamin B12, or Folate supplementation
- ***Other***: Hydroxyurea (SCD), Corticosteroids (AIHA)

Branch B: Management (Part II: Hemodynamic & Etiology)

- ***Unstable / Shock***: Rapid IV Isotonic Fluids (Sepsis) OR Inotropes (Cardiogenic)
- ***Endocrine Crisis***: Levothyroxine (HypoT), Hydrocortisone (Adrenal)
- ***Metabolic***: IV Dextrose (Hypoglycemia)
- ***Other***: Diuretics (Edema), Stop drugs, Chelation, or Parental Reassurance (Constitutional Fair Skin)

Etiology-Specific Management

1. Endocrine Disorders:

Hypothyroidism:

Initiate Levothyroxine replacement.

Adrenal Crisis (Stable post-resuscitation):

Stress-dose IV Hydrocortisone (50-100mg/m^2) + hydration.

Pheochromocytoma:

Pre-operative alpha-blockers (e.g., Phenoxybenzamine).

Etiology-Specific Management

2. Subcutaneous Edema (Masking Skin Perfusion):

Nephrotic Syndrome:

High-dose oral Prednisolone \pm diuretics for symptomatic fluid overload.

3. Autonomic / Transient Responses:

Vasovagal Syncope:

Supine positioning, leg elevation, oral fluids, and trigger avoidance (e.g., pain, fright).

Etiology-Specific Management

4. Toxins / Medication Exposure:

Vasoconstrictors:

Discontinue offending agents (e.g., OTC nasal decongestants like phenylephrine).

Lead Toxicity:

Chelation therapy (Succimer/DMSA) for confirmed severe toxicity.

5. Constitutional / Fair Complexion (Normal Variant):

Parental Reassurance:

Reassure parents using normal FBC and bright pink oral mucosa to prevent unnecessary iron therapy or repeated blood testing

PART 9

Summary and Discussion

Common Clinical Pitfalls in Pediatric Pallor

- ✓Treat the patient, not only laboratory results.
- ✓Avoid empirical iron before confirming microcytic indices
- ✓(risk in thalassemia trait).
- ✓Reticulocyte count reflects bone marrow activity.
- ✓Always assess clinical red flags first.

Critical Red Flags in Pediatric Pallor

- Hemodynamic instability.
- Petechiae/purpura, fever, recurrent infections.
- Hepatosplenomegaly or lymphadenopathy.
- Active bleeding.
- Jaundice and dark urine.

Clinical case

A 2-year-old child was brought to you in the clinic by his mother , she told you she noticed that he looks pale for 2 months and less active than before, Easy fatigability and decreased activity and Poor dietary intake with high milk consumption and,

by Examination Pale conjunctiva and Mild tachycardia.

Discussion:

1. What does this finding suggest?
2. What are the possible causes?
3. What investigations are needed?

Clinical case Discussion

2-year-old boy with pallor and high milk intake.

Likely IDA.

Differential: IDA, thalassemia trait, ACD, sideroblastic anemia, lead poisoning.

Investigations: CBC, smear, iron profile, retics, Mentzer index.

Management: Limit milk, oral iron 3–6 mg/kg/day, CBC after 4 weeks.

Key Take-Home Messages

- ✓ Pallor is a sign; anemia is a lab diagnosis.
- ✓ Rule out red flags before interpreting labs.
- ✓ Dietary history is often the key.

References

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- Kalantri A and others. *Accuracy and reliability of pallor for detecting anaemia: a hospital-based diagnostic accuracy study*. PLoS One. 2010 Jan

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THANK YOU