

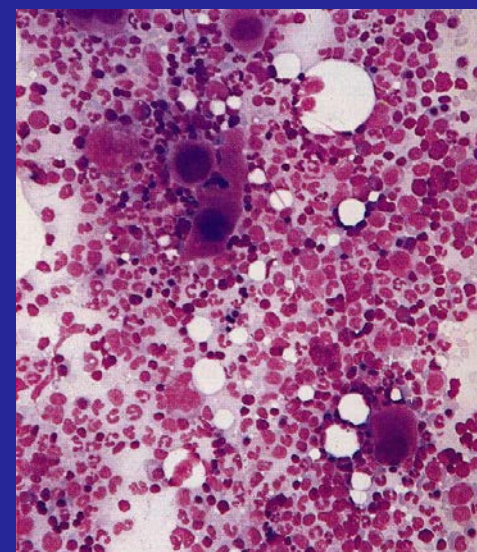
Essential Lab Interpretation : Hematology Aspect



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Outlines

- Basic knowledge for laboratory in Benign Hematology :
 - ✓ CBC and PBS
 - ✓ Osmotic fragility test
 - ✓ Platelet function testing
 - ✓ Coagulation studies



CBC interpretation

CBC (WITH PLATELET COUNT)(30101)(7.1.1.1)

WBC = 3.9 (4.4 - 10.8)*1000/ul

RBC = 4.9 (3.9 - 5.2)*1000000/ul

Hematocrit = 38.2 (35.7 - 45.1)%

Neutrophil = 45 (39.2 - 70.8)%

Lymphocyte = 36 (20 - 48.4)%

Monocyte = 12 (3 - 9.9)%

Eosinophil = 7 (.5 - 5.5)%

Basophil = 0 (.1 - 1.9)%

MCV = 78 (80.4 - 95.2)fl

MCH = 26.9 (26.5 - 32.2)pg

MCHC = 34.6 (32.3 - 34.5)g/dl

RDW = 13.7 (12.2 - 14.8)%

Platelet count = 244 (184.1 - 422)*1000/ul

MPV = 9.4 (6.5 - 9.5)fl

Hemoglobin = 13.2 (12.1 - 14.7)g/dl

- RBC : Hb, Hct, MCV, MCH, MCHC, RDW
- WBC : Total and differential count
- Platelet : Total count, MPV

RBC indices

- **MCV** = mean corpuscular volume = **size**
- **MCH** = mean corpuscular hemoglobin = **staining**
- **MCHC** = mean corpuscular hemoglobin concentration
If > 35 g/dl spherocytosis
- Red blood cell distribution width = **RDW**
detect variation in red cell size = **detect anisocytosis**

Classification of anemia according to erythrocyte size

Microcytic MCV < 80 fL

Iron deficiency
Thalassemia
Sideroblastic anemia

Normocytic MCV 81-90 fL

Acute blood loss
Renal anemia
Spherocytosis
G6PD deficiency

Macrocytic MCV > 95 fL

Vit B₁₂ deficiency
Folic acid deficiency
Chemotherapy
Myelodysplasia
Bone marrow failure
syndrome
Hemolysis



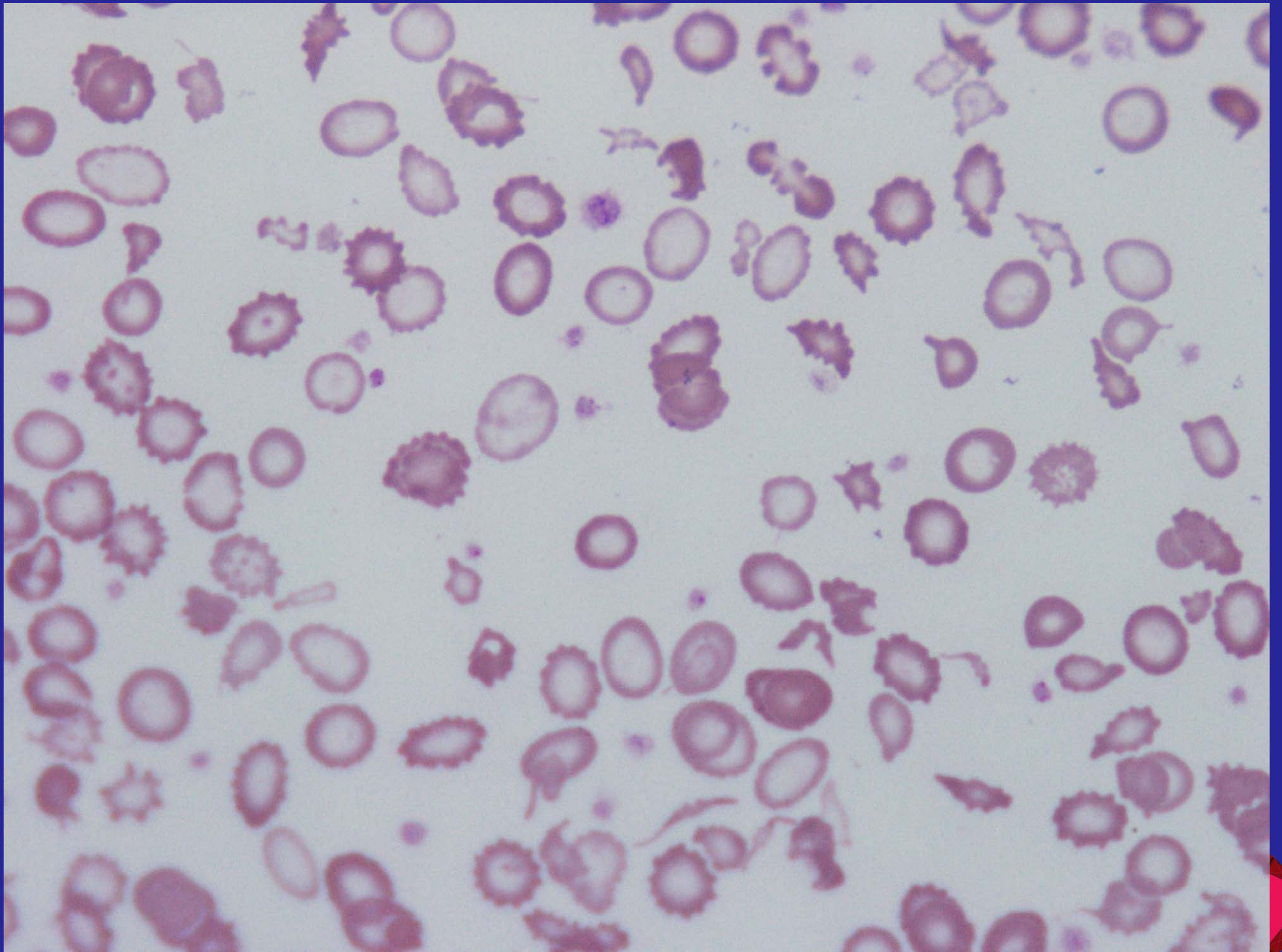
Hb Typing and RBC parameters Correlation



10 months old Thai boy

- Anemia
- Liver and spleen just palpable

CBC	
RBC($10^6/\text{mCL}$)	3.37 (4.1-6.1)
Hct (%)	19
Hb (g/dL)	5
MCV (fl)	45 (80-100)
MCH (pg)	18 (26-34)
MCHC (g/dL)	29.7 (31-37)
RDW (%)	28 (11.9-14.8)
Father	-- ^{SEA} / $\alpha\alpha$
Mother	β^0/β



Hb-GOLD

26.7°C. Off J

c PRAMONGKUT

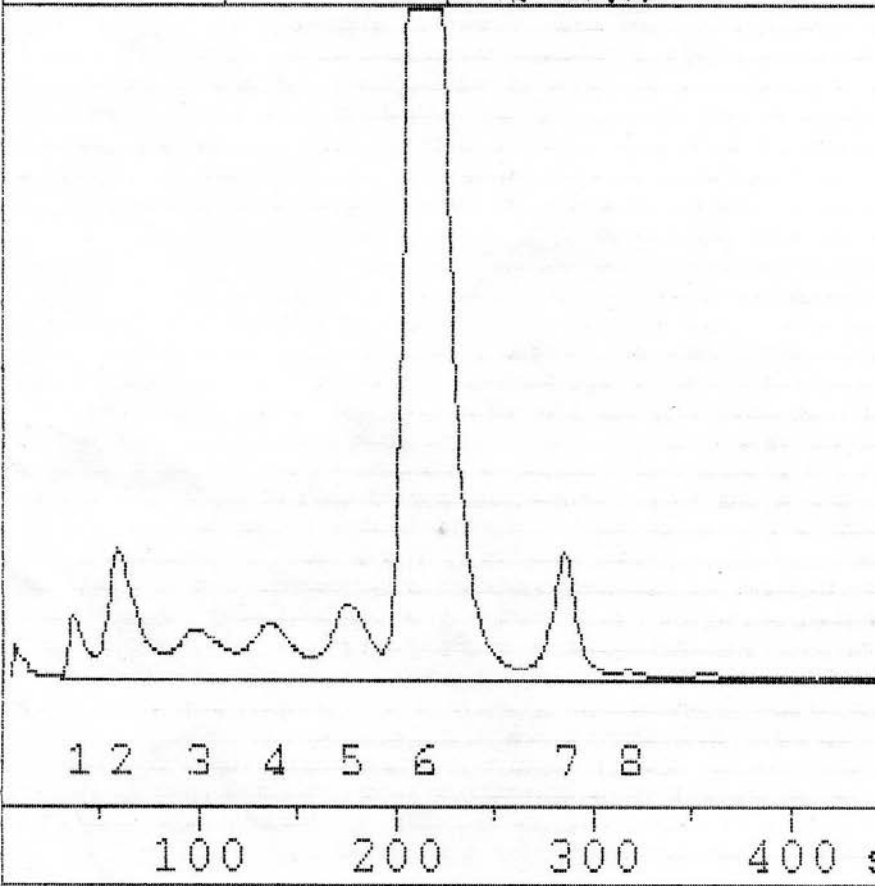
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AZ/Var

099.69726

Well 19

97kewin



Peak	RT(s)	% of HbA	% of Hb	GOLD
1	Unknown 37		1.4	53
2	Unknown 59		5.8	
3	A1c Window 98		3.9	
4	F Window 136		3.0	
5	Unknown 175		4.1	
6	A0 Window 212		76.4	
7	AZ Window 284		4.4	
8	Unknown 316		0.0	

Area= 622

Baseline= 17507



10 months old Thai boy

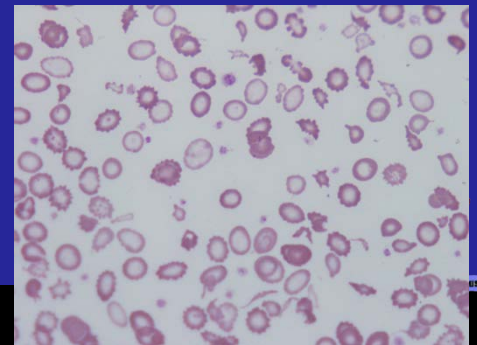
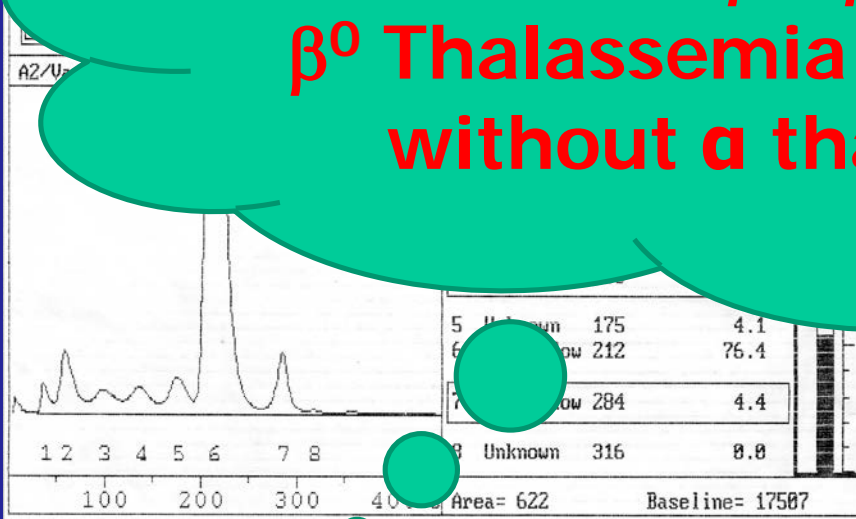
- Anemia
- Liver and spleen in 2nd ICS
palpable

CBC	
RBC(10^6 /mcL)	3.37 (4.1-6.1)
Hb (g/dL)	6.6 (9.5-13.5)
Hct (%)	21.9 (26.3-41.8)
MCV (fL)	65 (82-104)
MCH (pg)	19.7 (27-34)
MCHC (g/dL)	29.9 (32-36)
RDW (CV%)	14.9 (11.9-14.8)
PLT (10^9 /L)	400 (150-450)
WBC (10^9 /L)	11.5 (5-15)
NEUT (%)	72.7 (56-72)
LYM (%)	19.9 (20-26)
MO (%)	7.3 (6-10)
EOS (%)	0.1 (0-1)
PLA (%)	0.1 (0-1)
MPV (fL)	10.4 (7-12)
PdW (fL)	10.4 (10.4-13.6)
PdW CV (%)	18.5 (15-18)
SEAL	--SEA/ $\alpha\alpha$
Mother	β^0/β

A_2A (Hb A_2 > 3.5%)

β^0/β

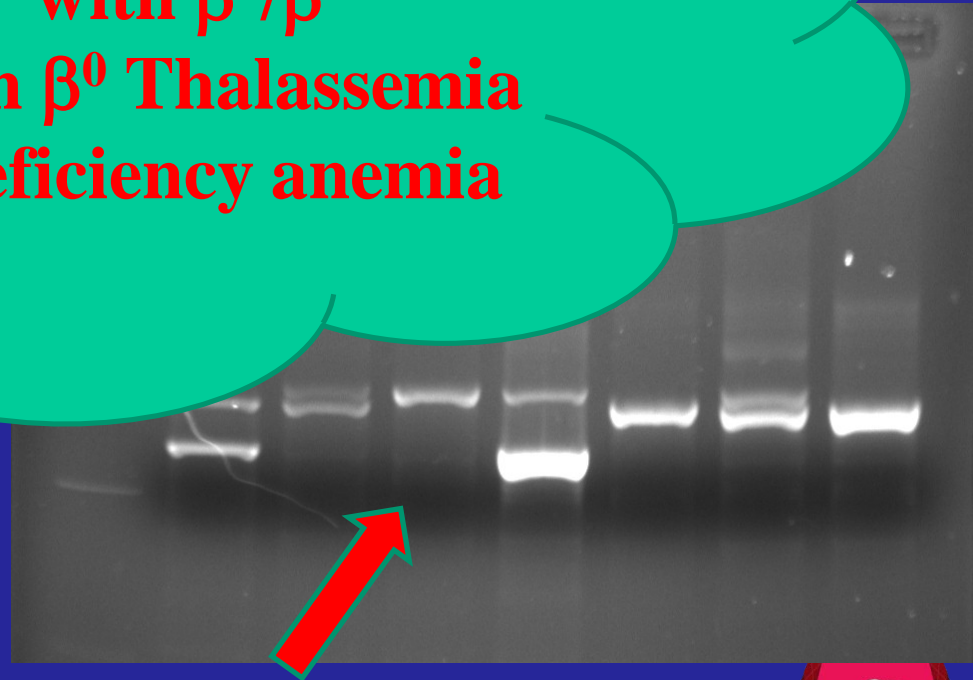
β^0 Thalassemia trait with or without α thalassemia



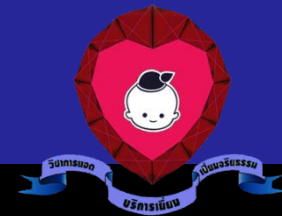
What should we do next?

- Inclusion body: Negative
- PC

— — SEA/— $\alpha^{3.7}$ with β^0/β
**Hb H disease with β^0 Thalassemia
trait with iron deficiency anemia**



RBC Membrane Defect



A 5-year-old boy presents with poor appetite. Physical examination reveals pallor, moderate icteric sclerae and splenomegaly.

Automated CBC:

Hb 8.4 g/dL

Hct 26 %

MCV 82 fL (> 78fL)

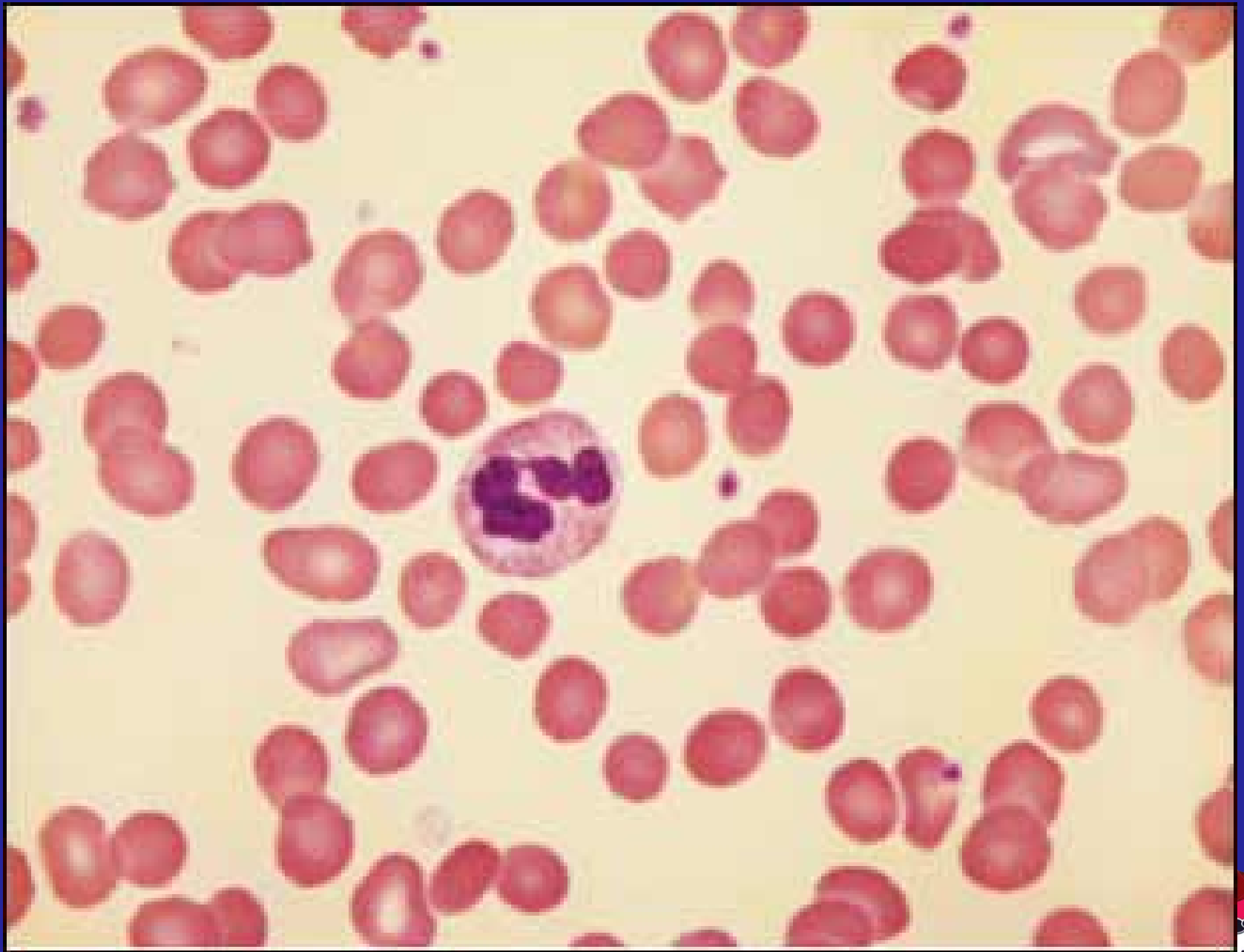
MCH 34 pg (>25 pg)

MCHC 37 g/dL (31-35 g/dL)

RDW 15 % (13-17%)

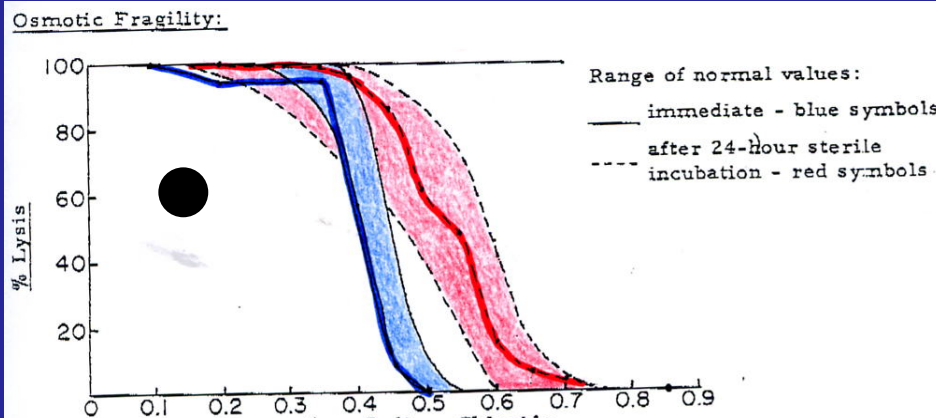
WBC 7,800 / mm³ P 50 % L 40 % M 10%

PLT 460,000 / mm³

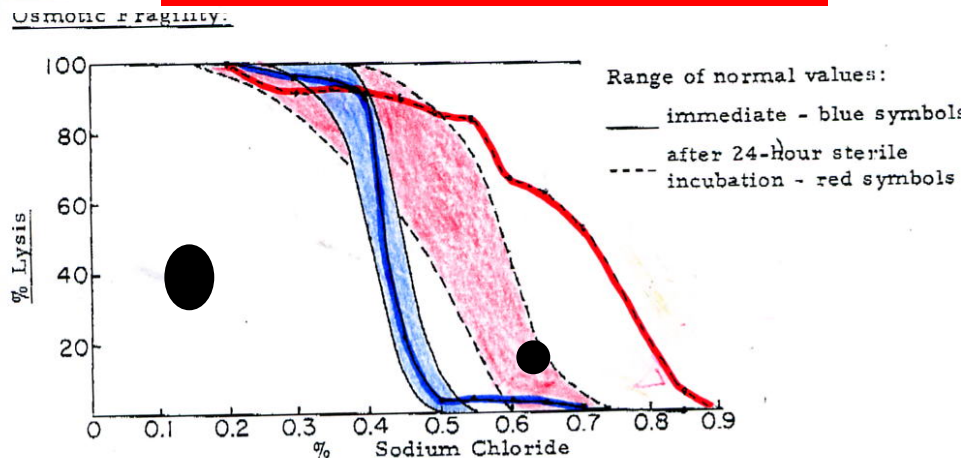




Incubated Osmotic Fragility Testing



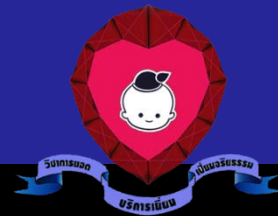
Normal Osmotic Fragility

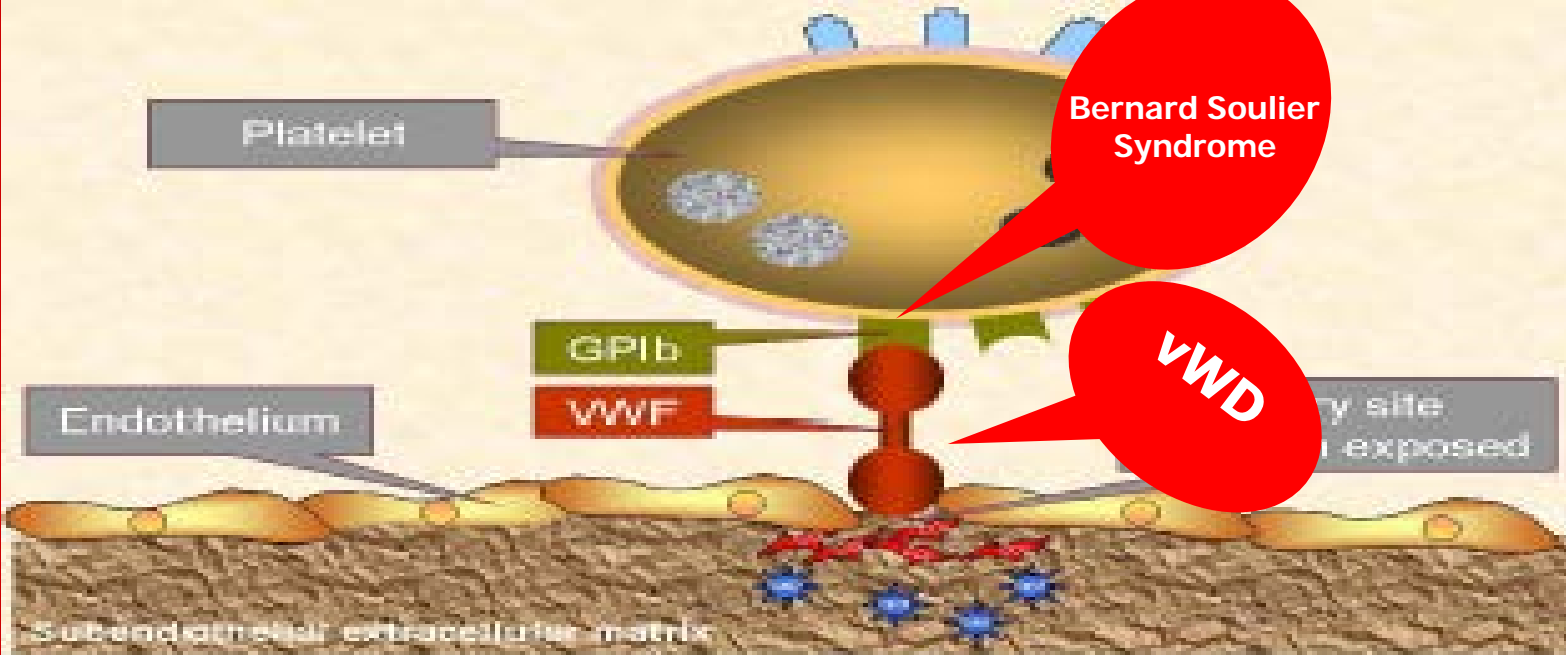


Increased Sensitivity to Lysis

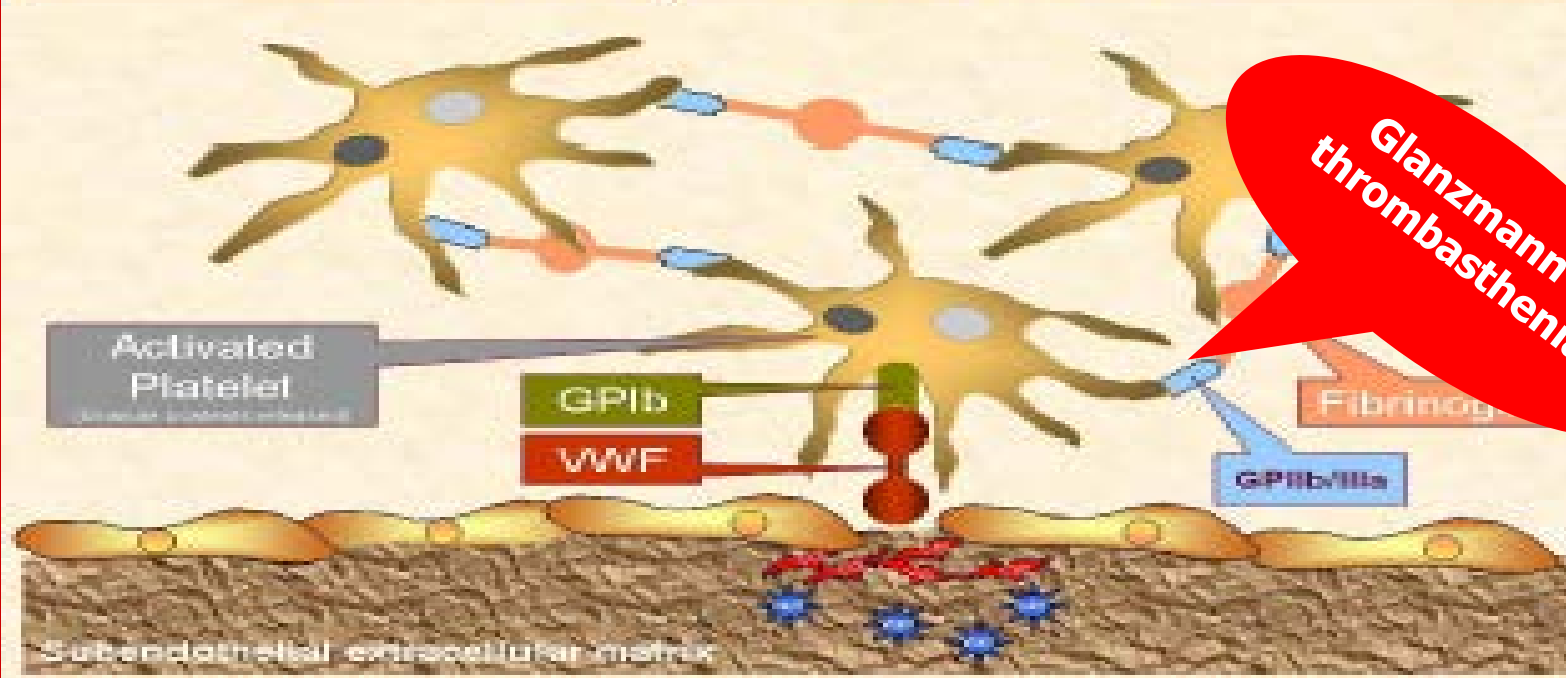
- Red cells are incubated in varying concentrations of saline (0 – 0.9%) for up to 48 hours
- As concentration of saline decreases, cells take on water and are hemolyzed
 - Normal cells around 0.5%
 - HS cells at higher NaCl concentrations
- Degree of hemolysis is detected by spectrophotometry
- Not reliable < 6-12 months of age

Platelet and Coagulation Studies





Primary Hemostasis

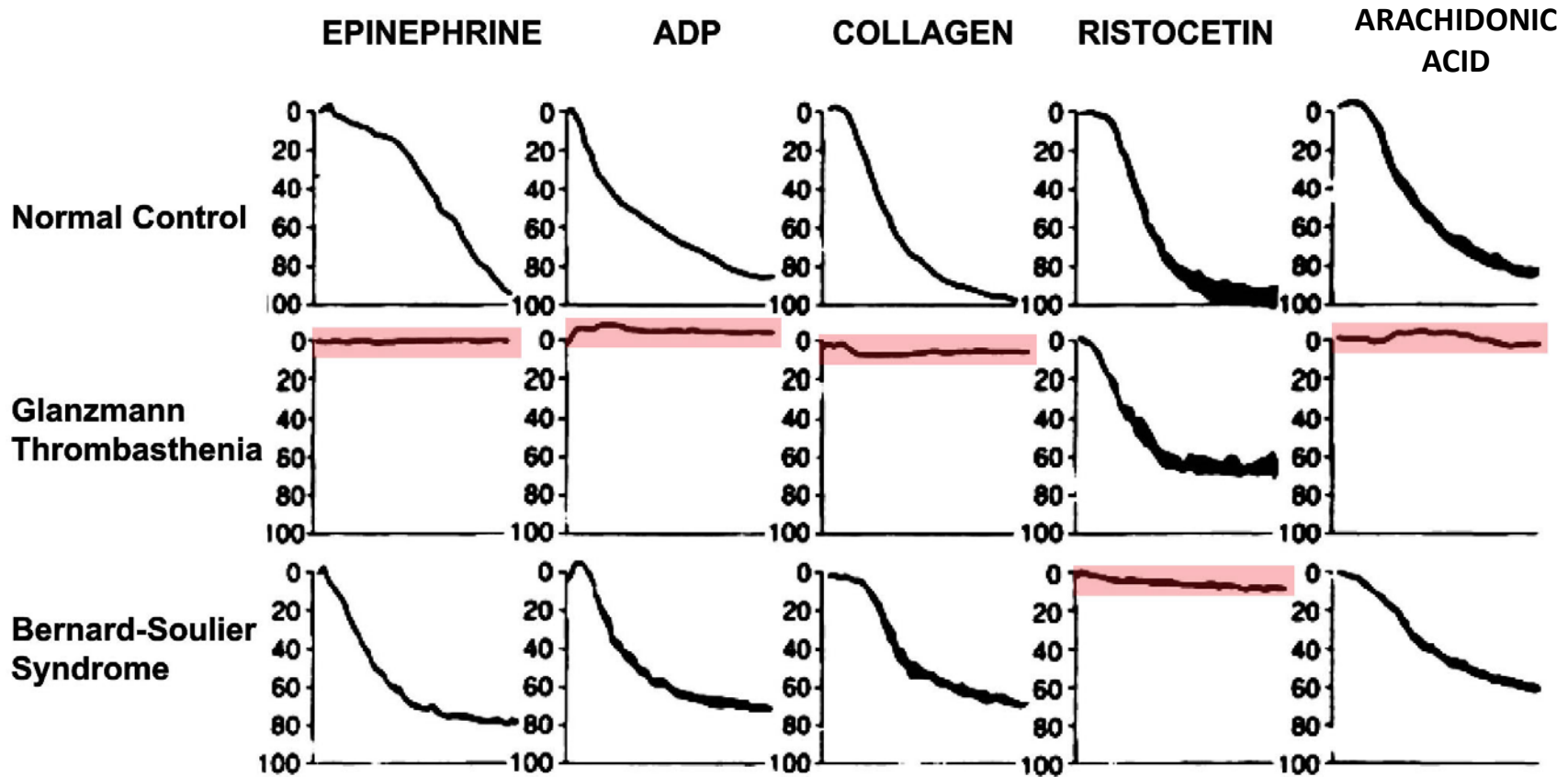


Ivy method

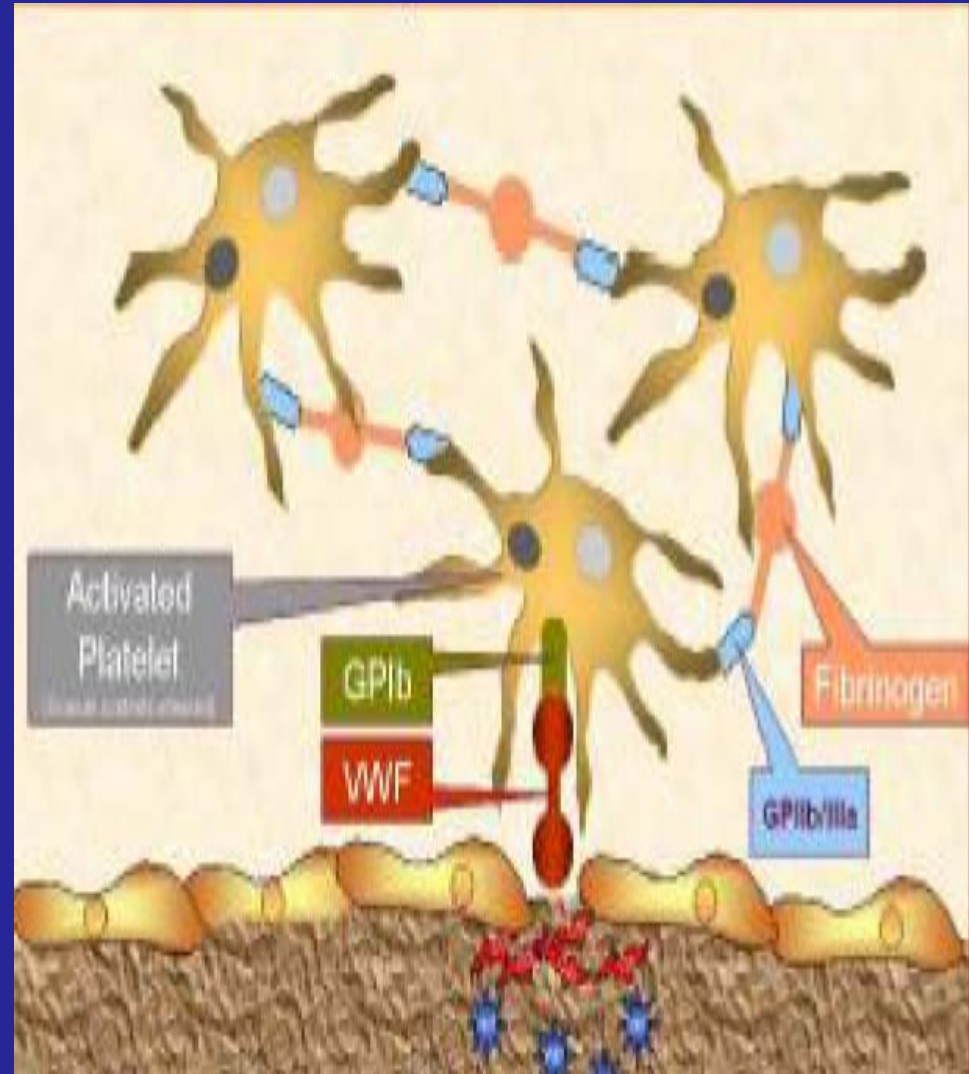


Normal range : typically 2 to 10 minutes
Accuracy if BT > 20 minutes

Platelet Aggregation Profiles



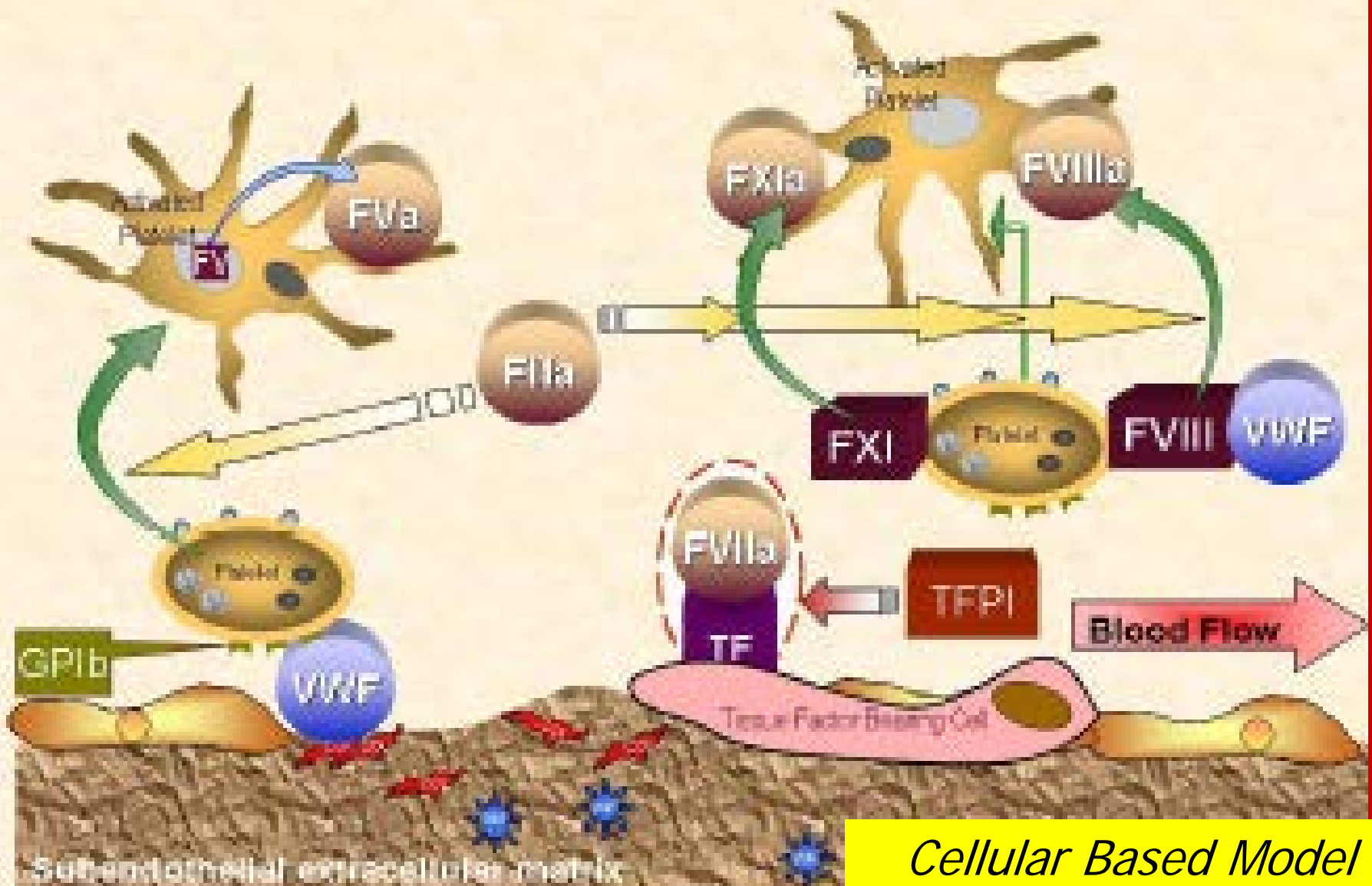
Clot Retraction



Clot retraction

- Positive in
 - GP IIb/IIIa defect (Glanzmann's thrombasthenia)
 - Afibrinogenemia/dysfibrinogenemia
- False positive
 - Thrombocytopenia

Secondary Hemostasis



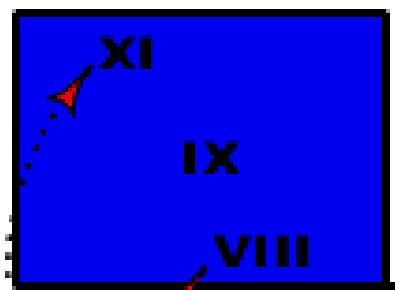
Cellular Based Model

CLOTTING FACTORS AND RELATED COAGULATION TESTS

Water Fall Model

INTRINSIC SYSTEM

XII

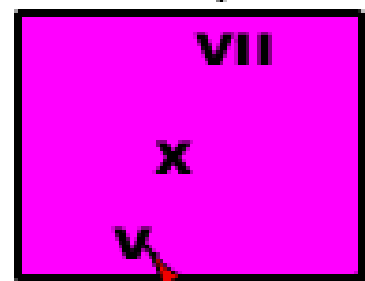


aPTT

Monitor
Heparin Therapy

EXTRINSIC SYSTEM

Tissue Factor
+



PT

Monitor
Coumadin Therapy

II → **Thrombin** ← II

fibrinogen

Fibrin

XIII

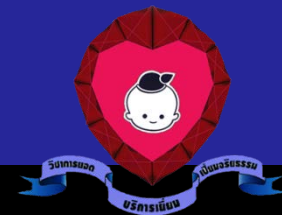
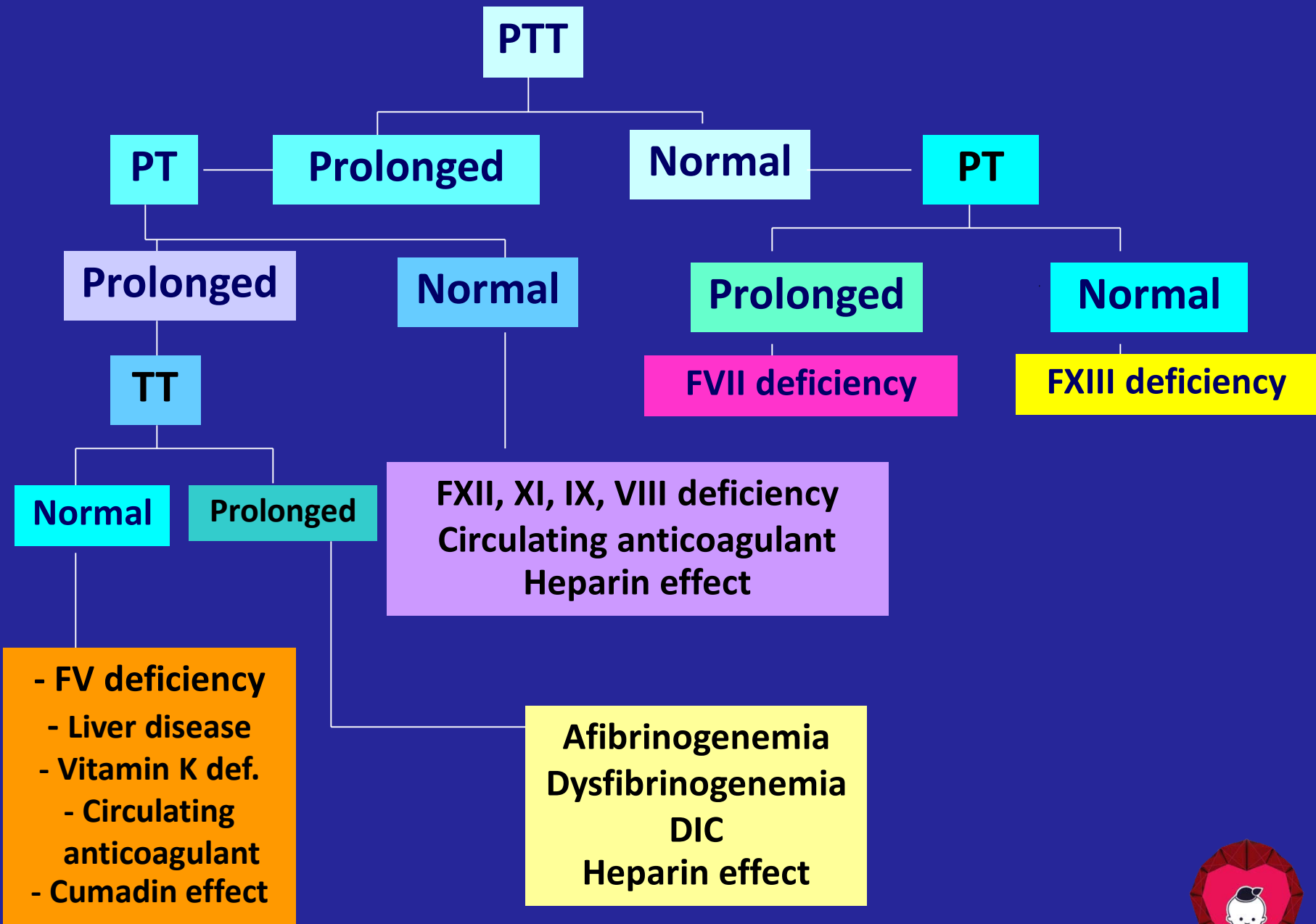
Fibrin stabilized

aPTT Procedure

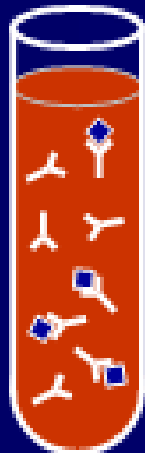
1. plasma sample
2. add Ca⁺⁺
3. add thromboplastin
4. add (-) charged foreign material
5. time elapsed to clot = aPTT

PT Procedure

1. plasma sample
2. add Ca⁺⁺
3. add thromboplastin
4. time elapsed to clot = PT

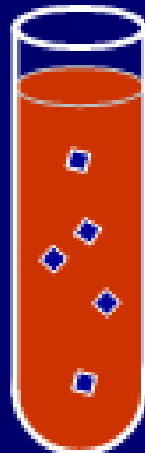


aPTT Mixing study

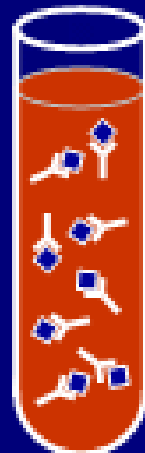


Patient

+



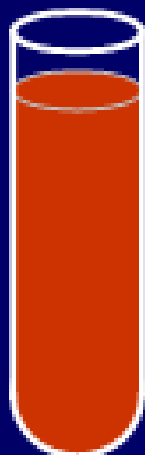
Normal



Not corrected

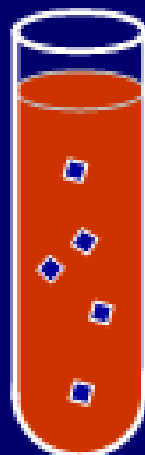
Clotting times
remain
prolonged =
Inhibitor

vs

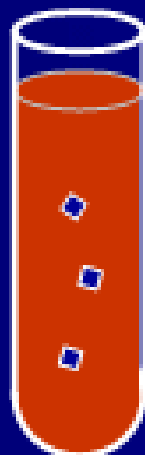


Patient

+

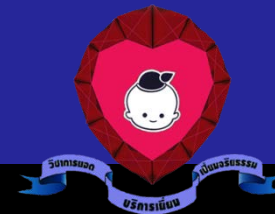


Normal

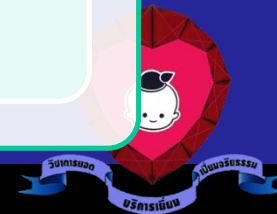
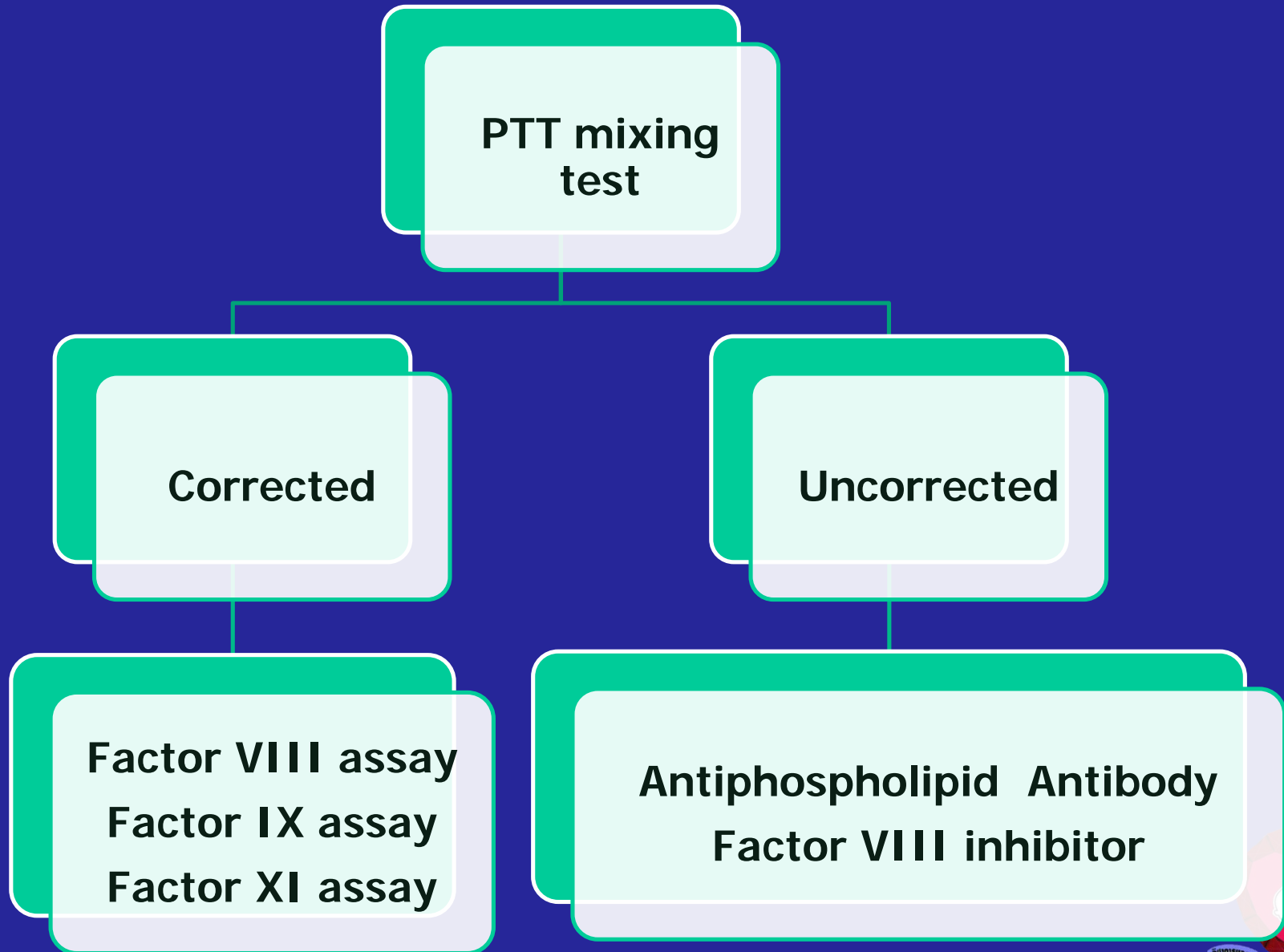


Corrected

Clotting times
normalize or
decrease to
near-normal =
Factor deficiency



Isolated PTT Prolonged



Mixing test

Sample	aPTT	PT
Normal control	34 sec	13 sec
Patient	54 sec	12.8 sec
Mixing study (1:1)	34.5 sec	13 sec

Diagnosis

Clotting factor deficiency

Further study

Specific factor assay e.g. FVIII:C, FIX:C

A 10 -year-old girl was planed to do elective tonsillectomy next week.

Automated CBC:

Hb	12.3 g/dL				
Hct	37 %				
MCV	83 fL	(> 78fL)			
MCH	29 pg	(>25 pg)			
MCHC	33 g/dL	(31-35 g/dL)			
RDW	14 %	(13-17%)			
WBC	5,800 / mm ³	P 50 %	L 40 %	M 10 %	
PLT	235,000 / mm ³				

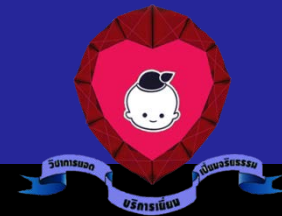


Coagulogram

PT = 14 sec (12-15 sec)

aPTT = 70 sec (25-35 sec)

TT = 13 sec (10-20 sec)



Mixing test

Sample	aPTT	PT
Normal control	34 sec	13 sec
Patient	70 sec	14 sec
Mixing study (1:1)	68 sec	13 sec

Diagnosis

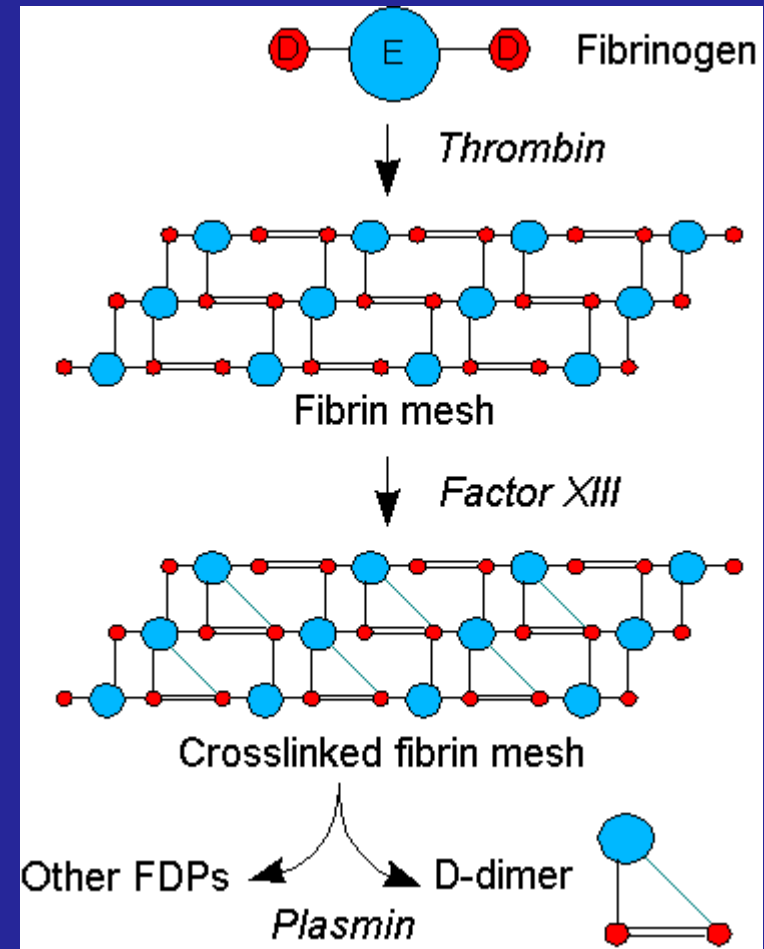
Antibodies

Further study

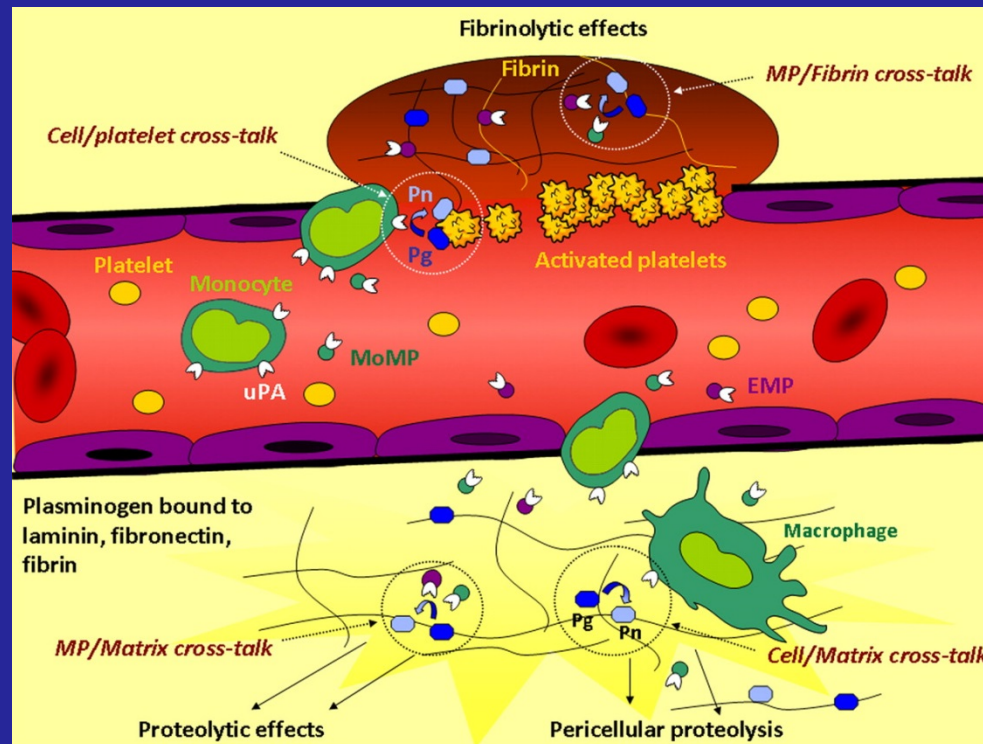
Lupus anticoagulant, β 2GPI, anticardiolipin

Clot Solubility Test

- 5M urea และ acetic acid
- Factor XIII deficiency
 - Positive : clot lysis
 - Control : normal plasma : not lysis



Euglobulin Lysis Time



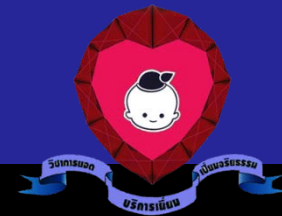
Normal > 24 hrs

< 30 Min : Hyperfibrinolysis

> 24-48 hrs : Hypofibrinolysis

6 months old boy presented with high grade fever, jaundice for 3 weeks

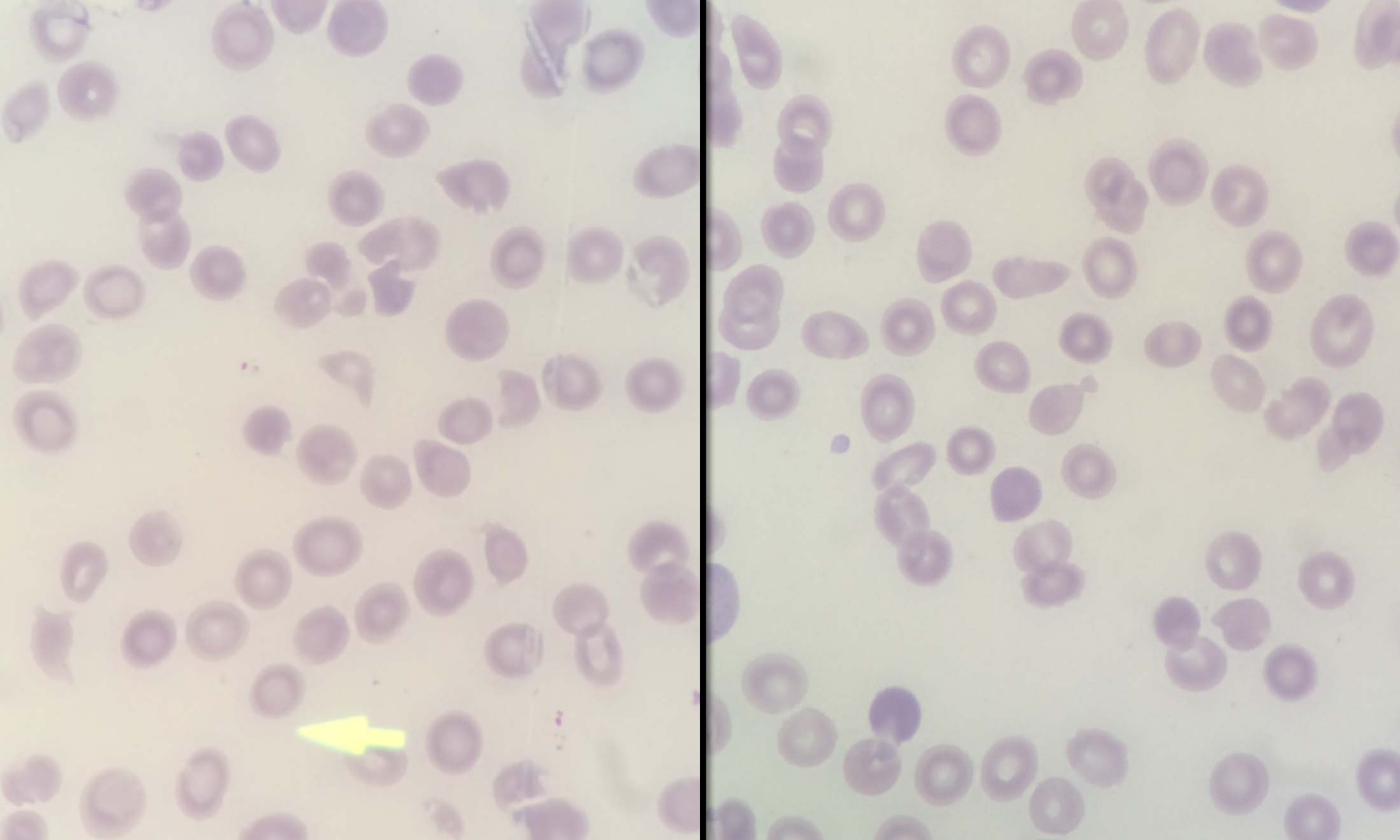
- PE:BT 39°C, PR 100/min, RR 24/min, BP 90/60 mmHg
- Moderate pale, mild jaundice, no lymphadenopathy
- Abdomen: Liver 3 cm below RCM and spleen 8 cm below LCM
- Neuro : No stiffneck, hypotonia 2+
- Others: WNL





CBC	
Hb (g/dl)	5.4
Hct (%)	17
WBC	26,600
PMN (%)	39
L (%) / AL	54
M (%)	5
E (%)	0
B (%)	0
Platelet	10,000
MCV (fl)	84
MCH (pg)	26
MCHC (g/dl)	31
RDW (%)	24
Reti.	3.35 %

Blood Chemistry	
Total protein	5.1
Albumin	2.9
TB	28.8
DB	23.5
AST	394
ALT	182
ALP	243
Gamma GT	9

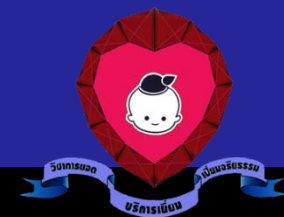


PBS : Normochromic, microcytic RBC, anisopoikilocytosis 1+, few schistocyte , few polychromasia, no toxic granule, no vacuolization, Platelet decrease

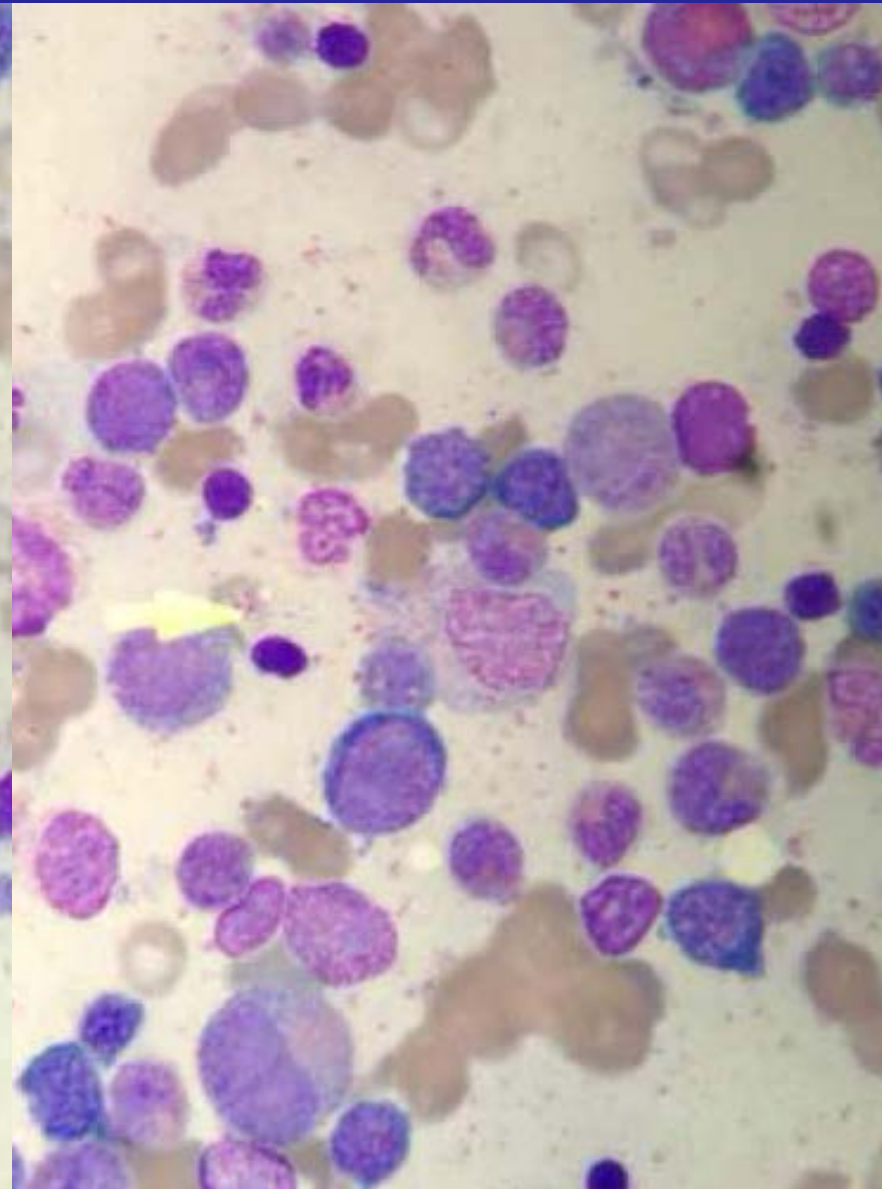
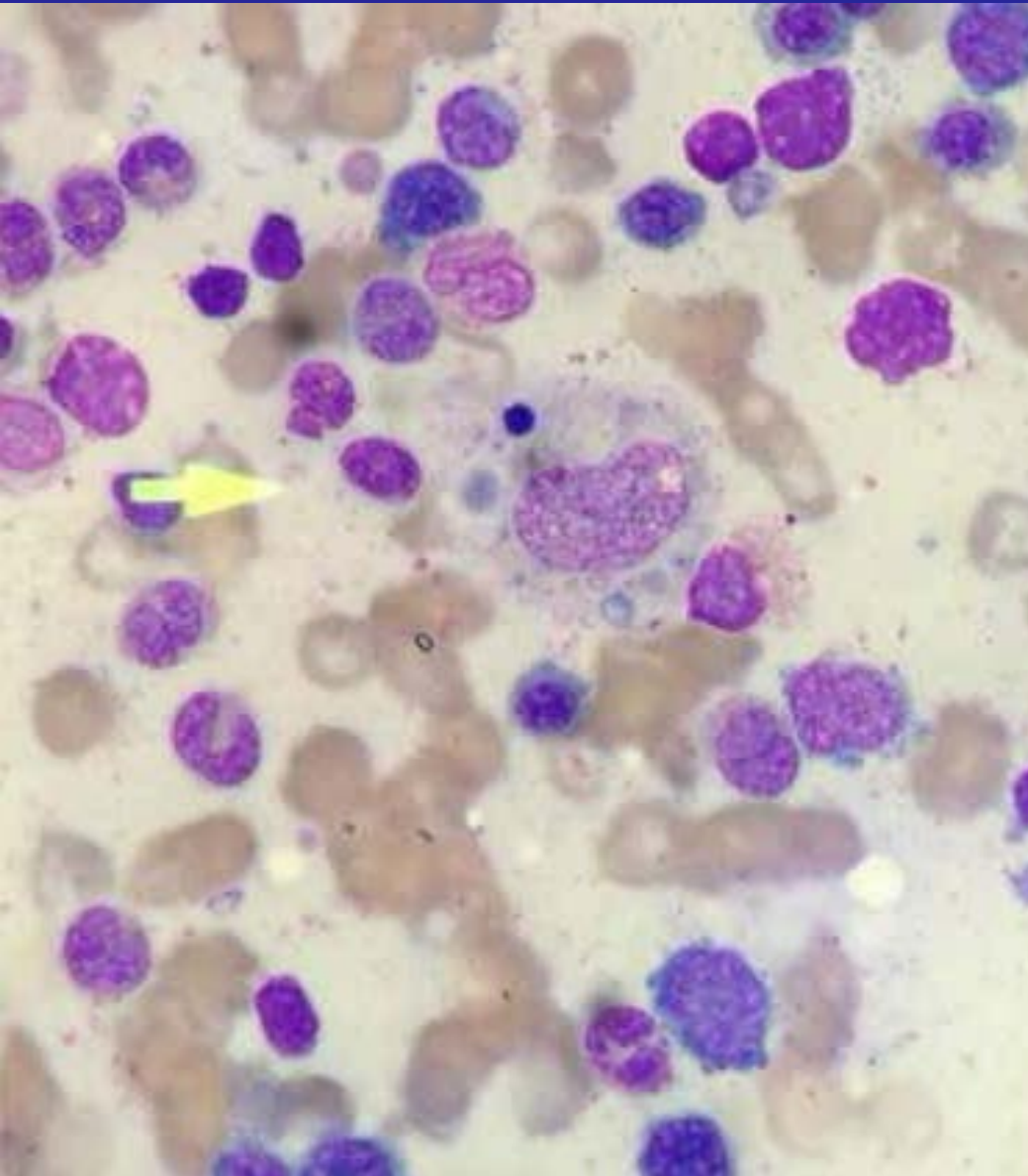
DCT : 1+ IDCT : negative

APTT	41.9
PT	17.8
INR	1.47
TT	17.4

Lab	
Triglyceride	206
Ferritin	1383
Fibrinogen	< 80
LDH	476
CPK	83



Investigation → Bone marrow aspiration



THANK YOU

