بسم الله الرحمن الرحیم

Interpretation of CBC in childhood

BY Dr Gholamreza Fathpour

Pediatric hematologist oncologist,HSCT fellowship
Shiraz, Iran.

Fars Pediatric Association

Interpretation of CBC

Hb, hematocrit, rbc count,

WBC count, platelet count

Rbc index :MCV, MCH, MCHC

RDW (Red cell distribution width)

Retic count

Normal range of Hb:

mean (range)

- Cord blood:16.8 (14-20)
- 3 mo: 12(9.5-14.5)
- 6mo-6yr: 12(10.5-14)
- 7-12yr: 13(11-16)
- Female: 14(12-16)
- Male: 16(14-18)

Mean (range)of MCV:

Cord blood :106(94-112)

2mo: 78(70-80)

2-8yr:{age+70} 75(73-86)

8-12yr: 83(76-86)

Female: 85(78-88)

Male: 84(77-90)

Newborn to adult

Age	Lowest Normal Hb (g/dL)	Normal Red Blood Cell Size Mean Corpuscular Volume (fL)	Fetal Hb (%)
Birth	14.0	100–130	55–90
1 mo	12.0	90–110	50–80
2 mo	10.5	80–100	30–55
3–6 mo	10.5	75–90	5–25
6 mo–1 yr	11.0	70–85	<5
1–4 yr	11.0	70–85	<2
4 yr–puberty	11.5	75–90	<2
Adult female	12.0	80–95	<2
Adult male	14.0	80–95	<2

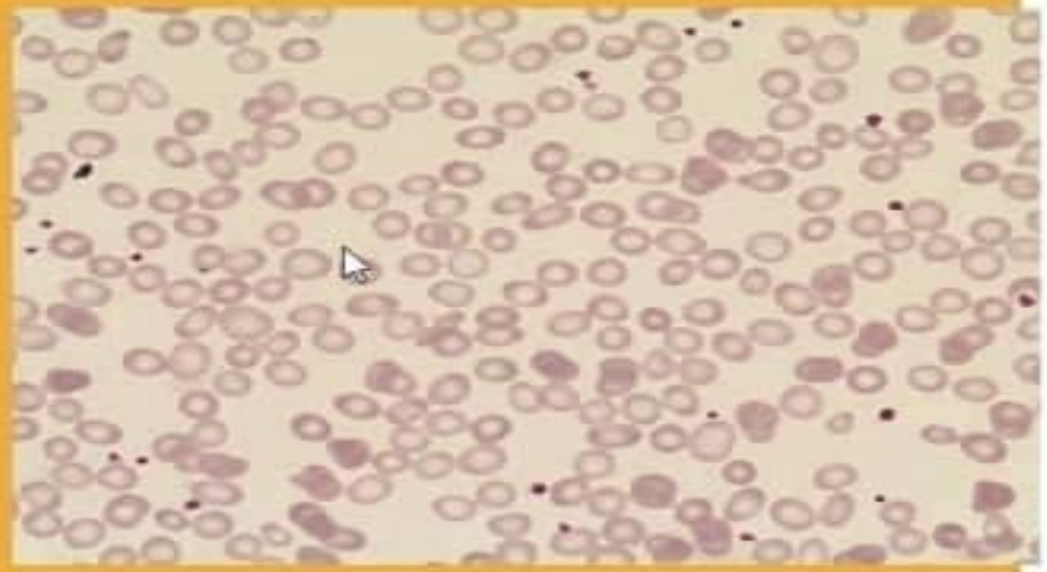
MCH

Definition :mean cell hemoglobin

27-32 pg

<27 :Hypochrome

MCH=Hb **×10/RBC**



MCHC

Definition:mean cell Hb concentration

32-36%

MCHC=Hb **x100** /Hct

Low MCHC means real hypochromia

Increased value if not due to spherocytosis is due to sample problems

RDW: (Red cell distribution width)

May be increased in any condition

Which sever anisocytosis is present.

(Iron deficiency, folate or B12 deficiency, thalassemia major or intermedia, sickle cell anemia,red cell fragmentation syndrome,…).

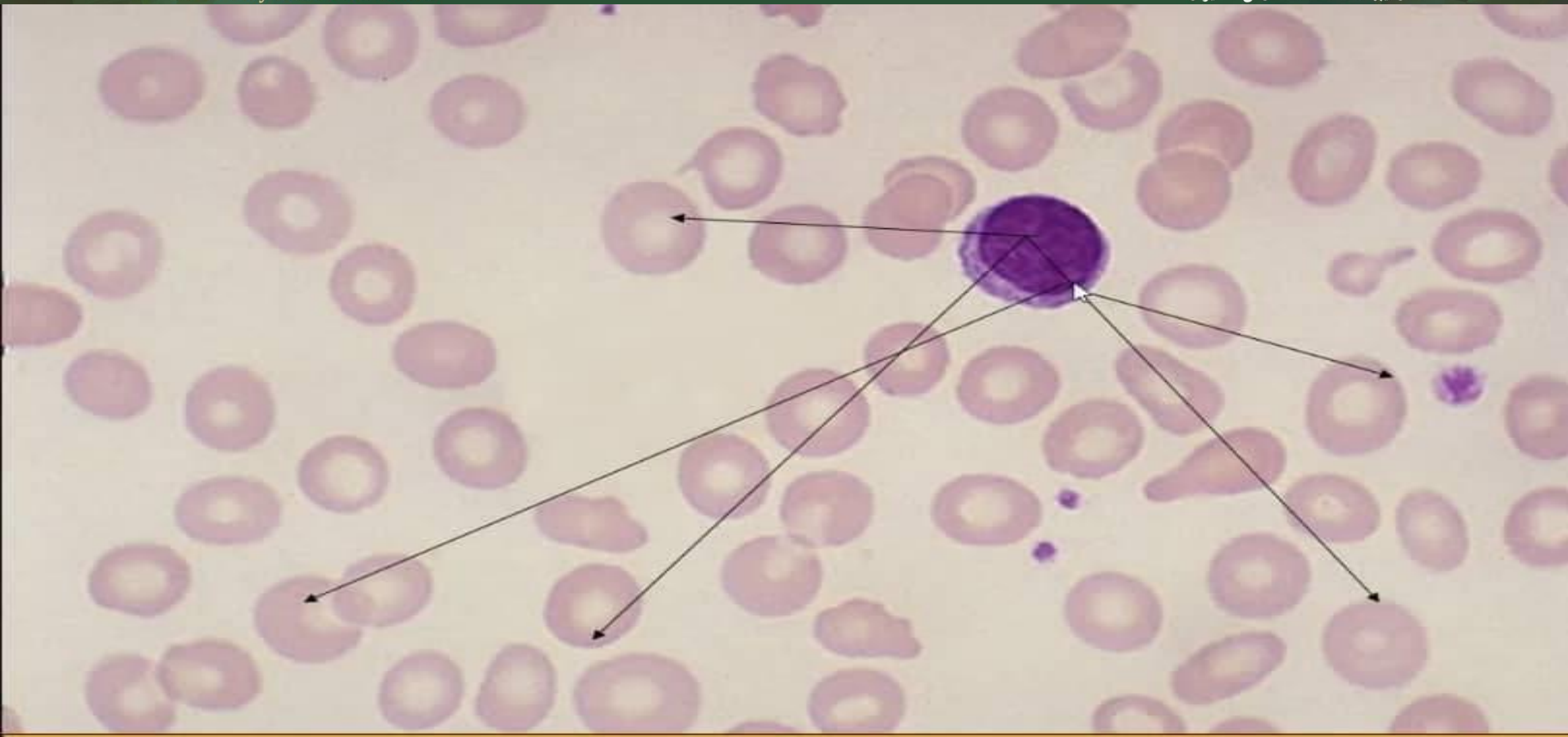
It is very helpful in DDx of microcytic anemias.

RDW

RED CELL DISTRIBUTION WIDTH
11.5-14.5%
Anisocytosis,,difference in seize

HDW

Hb DISTRIBUTION WIDTH
2.2-3.2%
Anisochromia,,difference in colors



The size of nucleous of small lymphocyte is used as a guide for the seize of normal RBC

Microcytic Anemia

- It is very common in all age groups.
- Iron deficiency is the most common acquired cause of anemia .
- Thalassemia is the most frequent gene mutation in human being.
- In a neonate MCV<94 is highly in favor of alpha thalassemia & Hb electrophoresis for detection of Hb Bart's (gamma 4) is indicated.

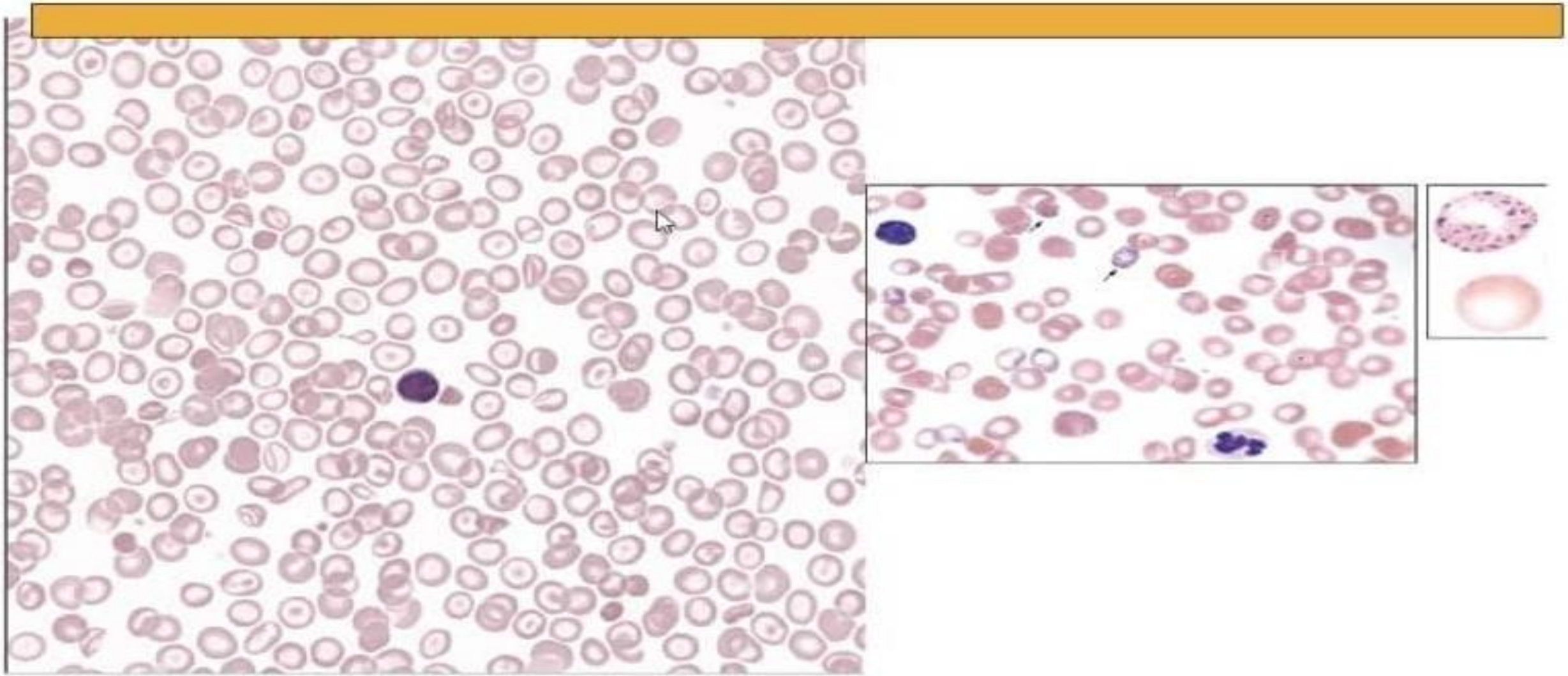
Microcytic Anemia with normal RDW

- Minor thalassemia :

  Alpha (Hb electrophoresis is Nl) beta (Hb A2= 3.5-7%)

  delta-beta (Hb F =2-15%)Deletion of delta & beta globin genes
- Anemia of chronic disease (in late stages specially in renal disease)
- Lead poisoning, copper deficiency
- Sideroblastic anemia

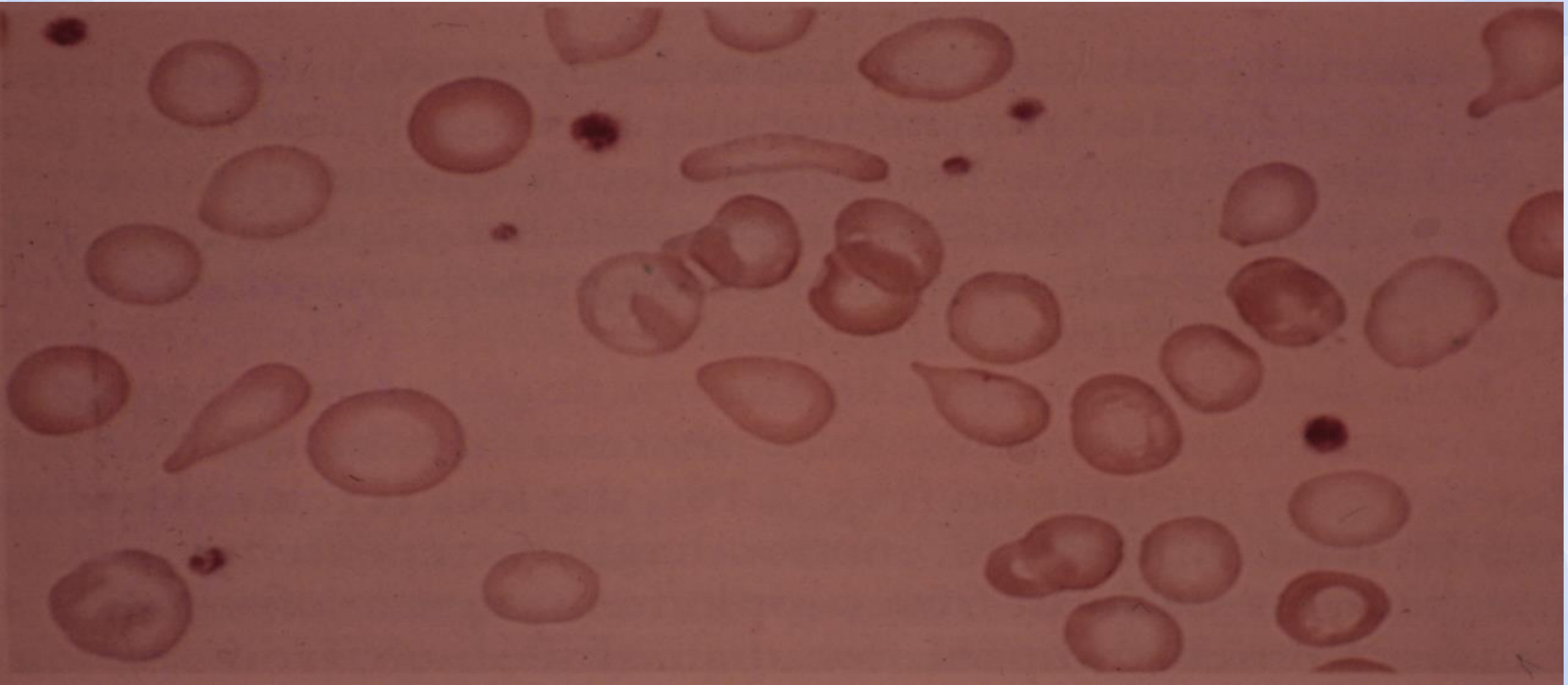
Thalassemia minor



Microcytic anemia with high RDW

- Iron deficiency anemia
- Beta thalassemia major & intermedia (high NRBC, high Hb F)
- Sickle thalassemia (high Hb S & F)
- Hb H disease (deletion of 3 alpha genes)
- Hb C and Hb E disease
- Red cell Fragmentation syndrome

لام خون محیطی فقر آهن



Kilonichia (Spoon nail)in Iron deficiency

DDx of minor thalassemia & iron deficiency

- Mentzer index: MCV / RBC
  - Note : Only If MCV <80 fl
  - < 13 :Minor thalassemia =>check Hb electro.
  - 13-15:Mixed Iron def. & minor thalassemia =>trial of iron + folate for 1 mo. Then check CBC & Hb electrophoresis
  - >15: Iron deficiency

DDx of minor thalassemia & iron deficiency

- Kerman index 1:(MCV*MCH/RBC)
- <250 : minor thalassemia =>check Hb elect.
- 251-320: mixed iron def. & minor thalassemia => trial of iron & folate then check CBC & Hb elect
- 321-370: iron def.=> trial of iron for 1 mo.
- >371: normal
- Sensitivity =99% , Specificity=86%

DDx of minor thalassemia & iron deficiency

Kerman index 2:MCV*MCH/RBC*MCHC

<8 : Minor thalassemia

8-10.5: Mixed iron def & minor thal.

10.5-13: Iron deficiency

>13: Normal

Note : Sensitivity=99% , Specificity=93%

NORMOCYTIC ANEMIA WITH NORMAL RDW

- Anemia of chronic disease
- Non-anemic hemoglobinopathy (Hb S ,C ,D trait)
- Post chemotherapy
- Spherocytosis,Ovalocytosis
- CLL (WBC <150000)

NORMOCYTIC ANEMIA WITH HIGH RDW

- Mixed deficiency (Folate & Iron)
- Early iron or folate deficiency
- Anemic hemoglobinopthy (Hb SS, Hb SC, Hb SD, Hb SG,…)
- Myelofibrosis
- Sideroblastic anemia

MACROCYTIC ANEMIA WITH NORMAL RDW

- Aplastic anemia (Fanconi)(untransfused)
- Preleukemia (Myelodysplastic Syndrome)
- Bleeding in perinatal period

Fanconi Sx

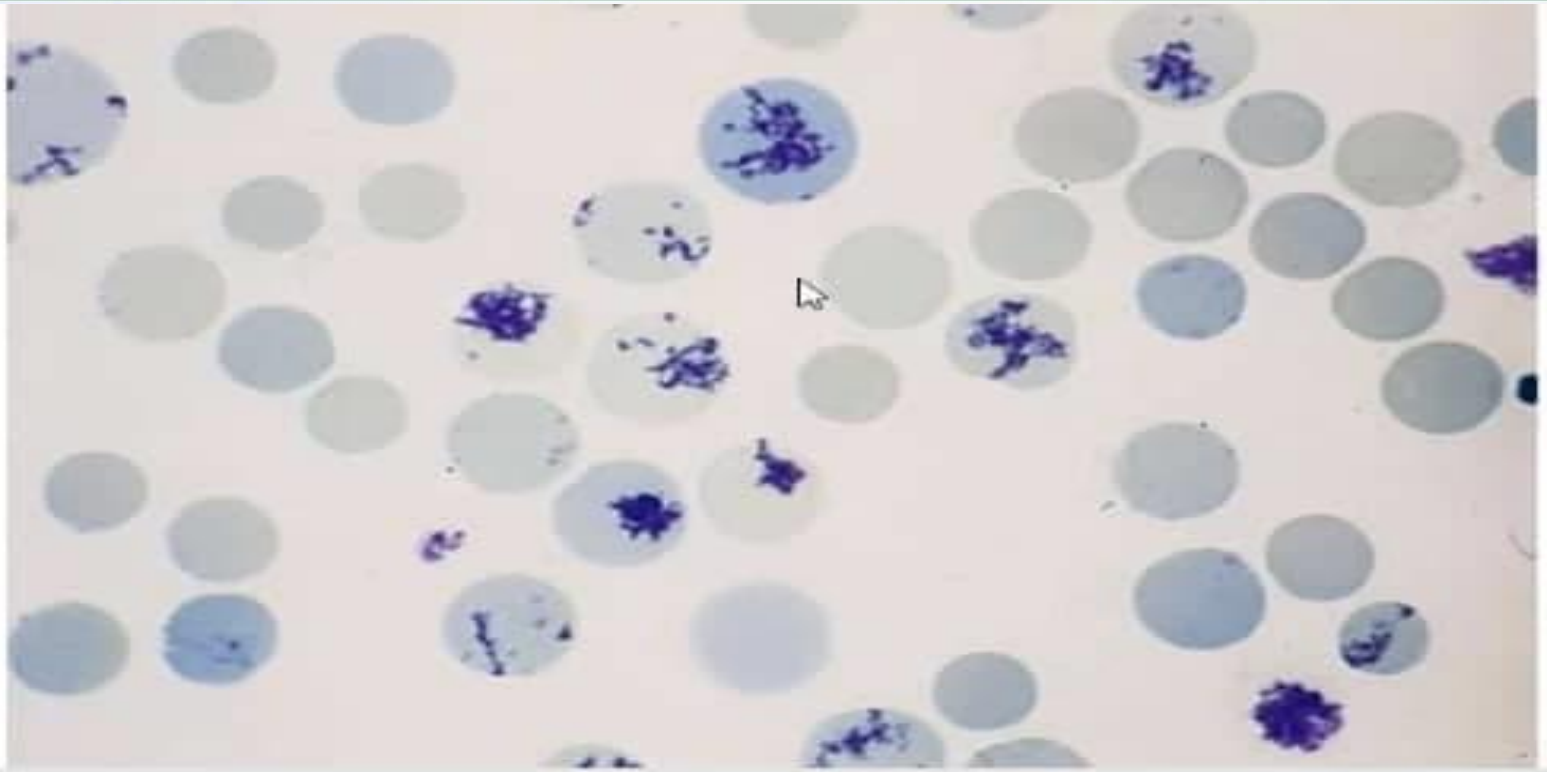
MACROCYTIC ANEMIA WITH HIGH RDW

- Folate deficiency
- B12 deficiency
- Aplastic anemia (Fanconi) (transfused)
- Immune hemolytic anemia (Rosette)
- Cold agglutinins (Roleux formation)
- C.L.L (WBC > 150000)

Retic count

It is useful in the DDx of hemolysis or chronic blood loss. It is increased in immune hemolytic anemia , spherocytosis, ovalocytosis, G6PD deficiency hemolysis, ….

But in the Thalassemia syndrome presence of NRBC is more prominent than reticulocytosis.



$$RPI = \frac{\text{هماتوکریت بیمار} \times \text{درصد رتیکولوسیت بیمار}}{\text{زمان بلوغ} \times \text{هماتوکریت طبیعی}}$$

مثال : اگر درصد رتیکولوسیت بیماری با هماتوکریت 30% برابر با 7/8% باشد :

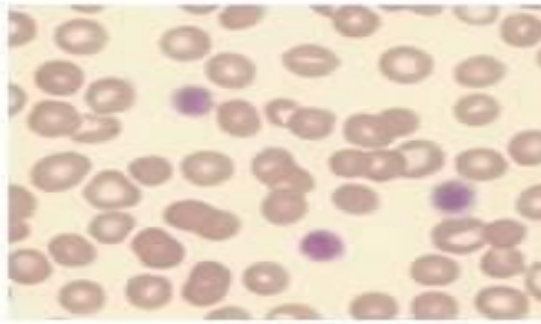
$$RPI = (7.8 \times 30) \div (45 \times 2) = 2.6$$

- **Total WBC Count : 4000 – 11000 / cu.mm.**
- **Differential count**

Leukocyte	Percentage
Neutrophils	40 – 70 %
Eosinophils	1 – 4 %
Basophils	0 – 1 %
Monocytes	4 – 8 %
Lymphocytes	20 – 40 %

MPV

Mean platelet volume....7-11 femtoliter
High platelet count and low MPV is indicative of acute phase cell in inflammatory and infectious disorders ,eg platelet 500000/ul and MPV=5
Low platelet and increased MPV means destruction op platelets in peripheral blood eg plat 20000 and MPV =13
ITP,Thyrotoxicosis,,DIC,TTP,HIV,,,,



Thank you for attention, Is there any question?