ABC OF CBC

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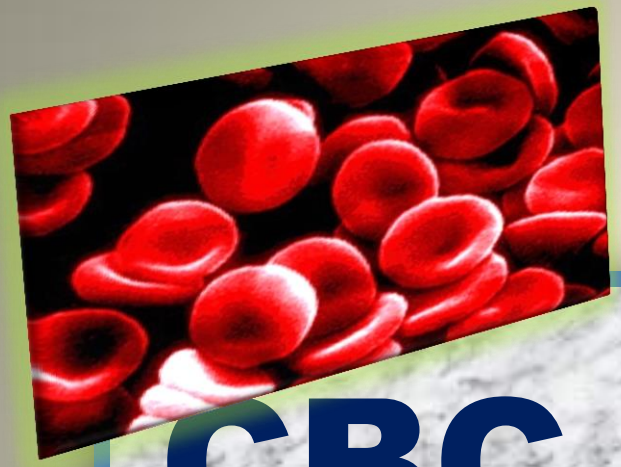
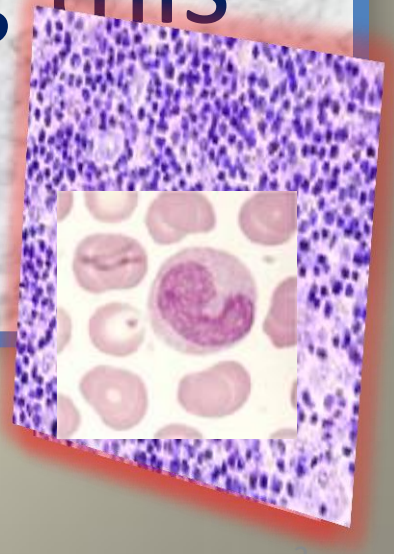


CBC.....What is the UTILITY of performing this basic Hematology Test?



Half of our population suffer from anemia

Infectious diseases
Acquiring epidemic proportions
Malaria on the rise.....!!
Cases of **Dengue** fever
&
Platelet & DIC related problems
are reported more frequently

#...Up to 15% of population in certain communities are carriers of Thalassemia gene....!!

ON TOP OF EVERYTHING...
The preliminary diagnostic information this single test can generate and make available
AS GUIDE
for proceeding further towards the Final Diagnosis is
UNIQUE

AUTOMATION & INTERPRETATION

Automation has changed principles and methodologies, approaches and conclusions of various disciplines of medicine

But…

Few branches are modified to the extend that their entire philosophy is so much reoriented that it needs to be re-written

and

HEMATOLOGY IS ONE OF THEM.

PARAMETERS LIKE RDW & HISTOGRAM

AUTOMATION & INTERPRETATION

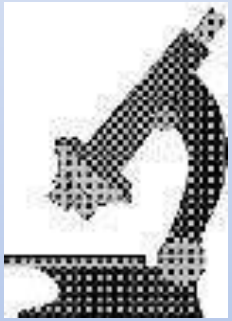
BUT ..the fact remains ……automation is

NO REPLACEMENT

for the study of **Peripheral smear**

it just **COMPLEMENTS**

Manual Microscopy



AUTOMATED BLOOD CELL COUNTERS

WHAT A DOCTOR SHOULD KNOW FOR INTERPRETATION OF RESULTS

PARAMETERS PROVIDED BY AUTOMATED HEMATOLOGY ANALYZERS

Measured parameters

- Hemoglobin (**Hb**)
- Hematocrit (**HCT/PCV**)
- RBC count (**RBC #)**
- Platelet count (**PLT #)**
- WBC count (**WBC #)**
- WBC diff. **(WBC %)**

Alerts/Flags

Derived parameters

- **MCH** (Hb/RBC #)
- **MCV** (HCT/RBC #)
- **MCHC** (Hb/HCT)
- **RDW** (RBC volume)
- **MPV** (Plt TV/PLT

Histograms & Scatter Plots (RBC, WBC & PLT)

RED CELLS

- Remarkable & dramatic improvement in the reproducibility of blood cell counters .

These parameters could be put to practical use in anemia classification.

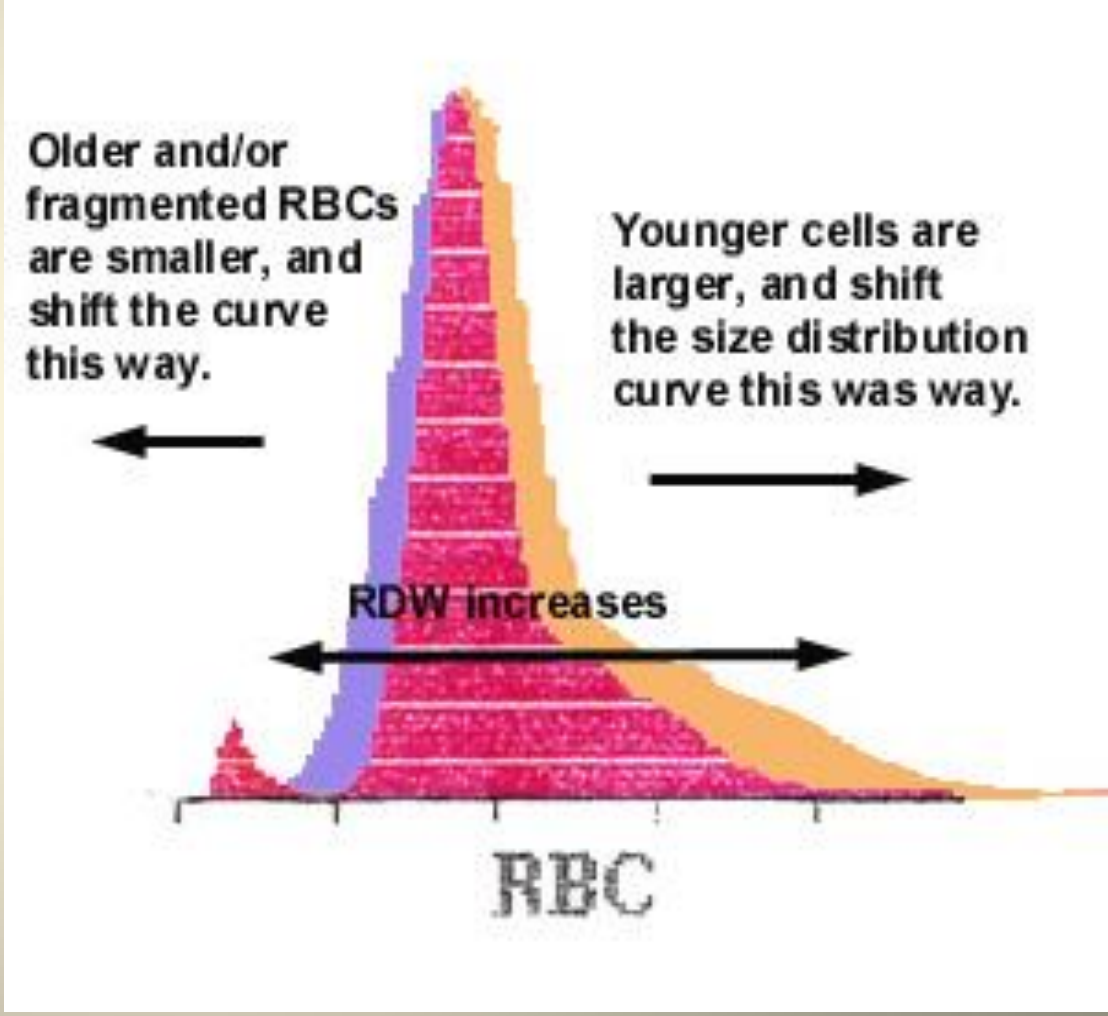
- **MCV – Mean Cell Volume (microcytes, normocytes, macrocytes)**
- **MCH – Mean Cell Hemaglobin (hypochromia etc.)**
- **MCHC – Mean Cell Hemoglobin Concentration (hemoglobinisation)**

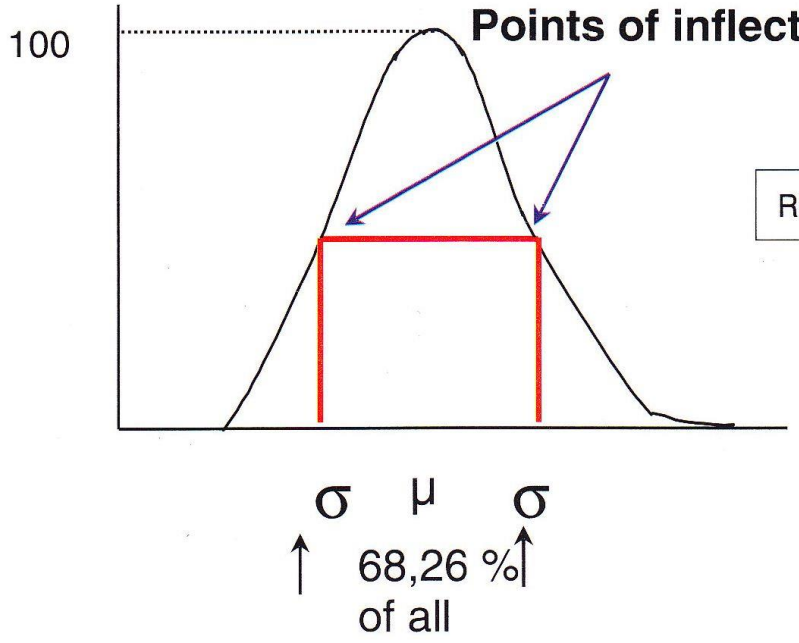
RED CELL DISTRIBUTION WIDTH (RDW)

- **RDW is a measure of variation in red cell size - anisocytosis**
- **Expressed as coefficient of variation (CV 11-16%) or in standard of deviation (SD 37-46fl)**
- **RDW- CV : ratio of standard deviation(SD) of the distribution width divided by the "mean red cell volume" (MCV).**
- **RDW-SD: actual distribution width of RBC population at 20% above the baseline.**
- **Unlike most variables, in which there are abnormally high and abnormally low values – No disorder is known to have abnormally low RDW.**

RDW

- RDW is an expression of the homogeneity of the RBC population size.
- A large RDW says there's a wide variation in the RBC diameters within the test pool.
- It doesn't say the cells are large or small, rather that the population is not homogenous.
- Younger cells are larger (reticulocytes).
- Older, and generally beat up, RBCs are smaller.

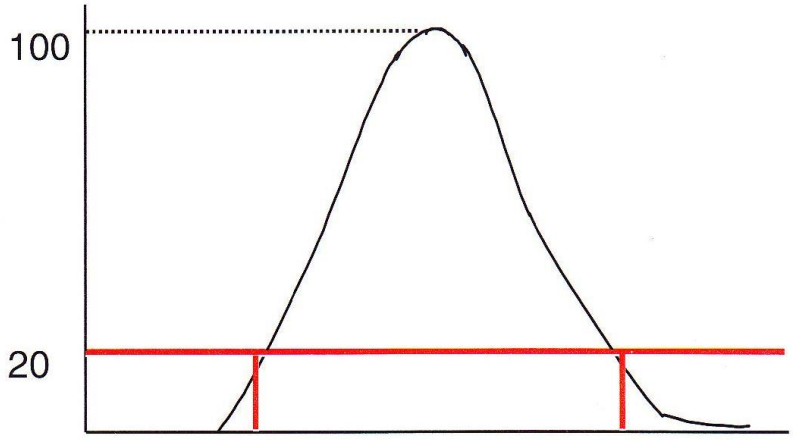




- RDW-CV:

  Calculated by SD/MCVx100

  Normal range: 10.4-15.2%



- RDW-SD:

  Not a statistical SD

  Obtained from the RBC histogram

FIG 4: RDW

CLASSIFICATION OF ANEMIAS BASED ON MCV & RDW

MCV Low		MCV Normal		MCV High	
RDW Normal	RDW High	RDW Normal	RDW High	RDW Normal	RDW High
Chronic disease	Iron deficiency	Normal	Early or mixed nutritional deficiency	Aplastic anemia	Folate or vitamin B_{12} deficiency
Nonanemic heterozygous thalassemia	Hb S-α or β thalassemia	Chronic disease	Anemic abnormal hemoglobin		Sickle cell anemia (⅓ of cases)
Children	Hb H	Nonanemic hemoglobin or enzyme abnormality	Myelofibrosis		Immune hemolytic anemia
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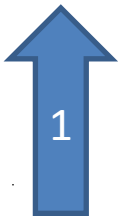
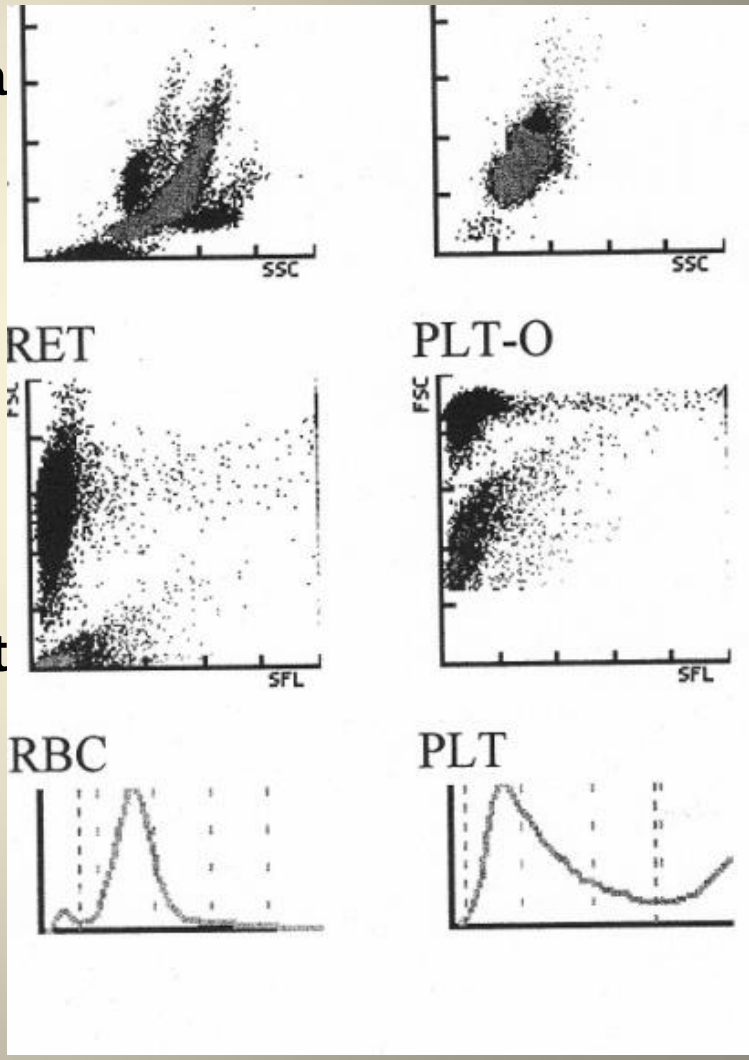
		Acute blood			Newborn



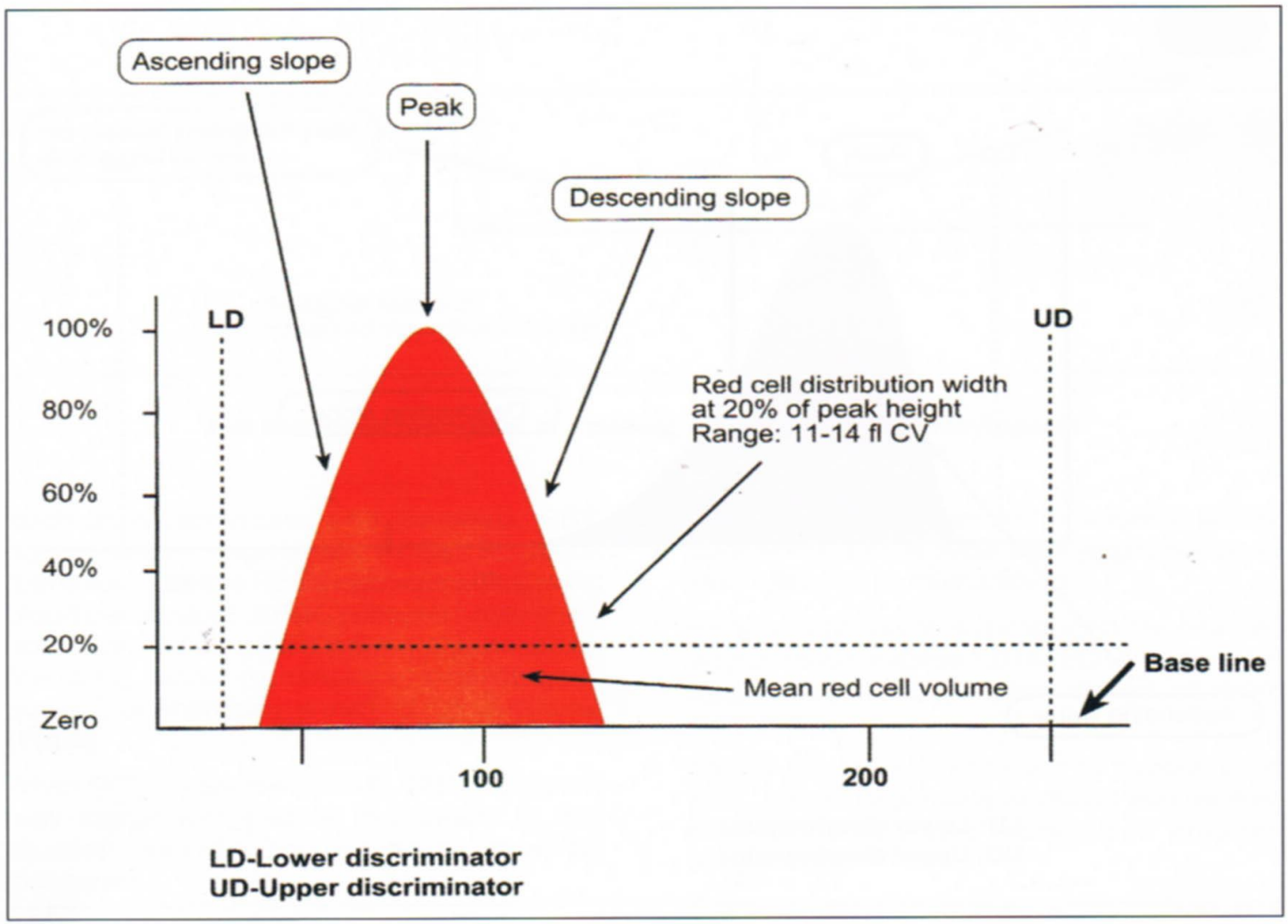
DISTRIBUTION CURVES/HISTOGRAMS

Histograms - Scatter plots

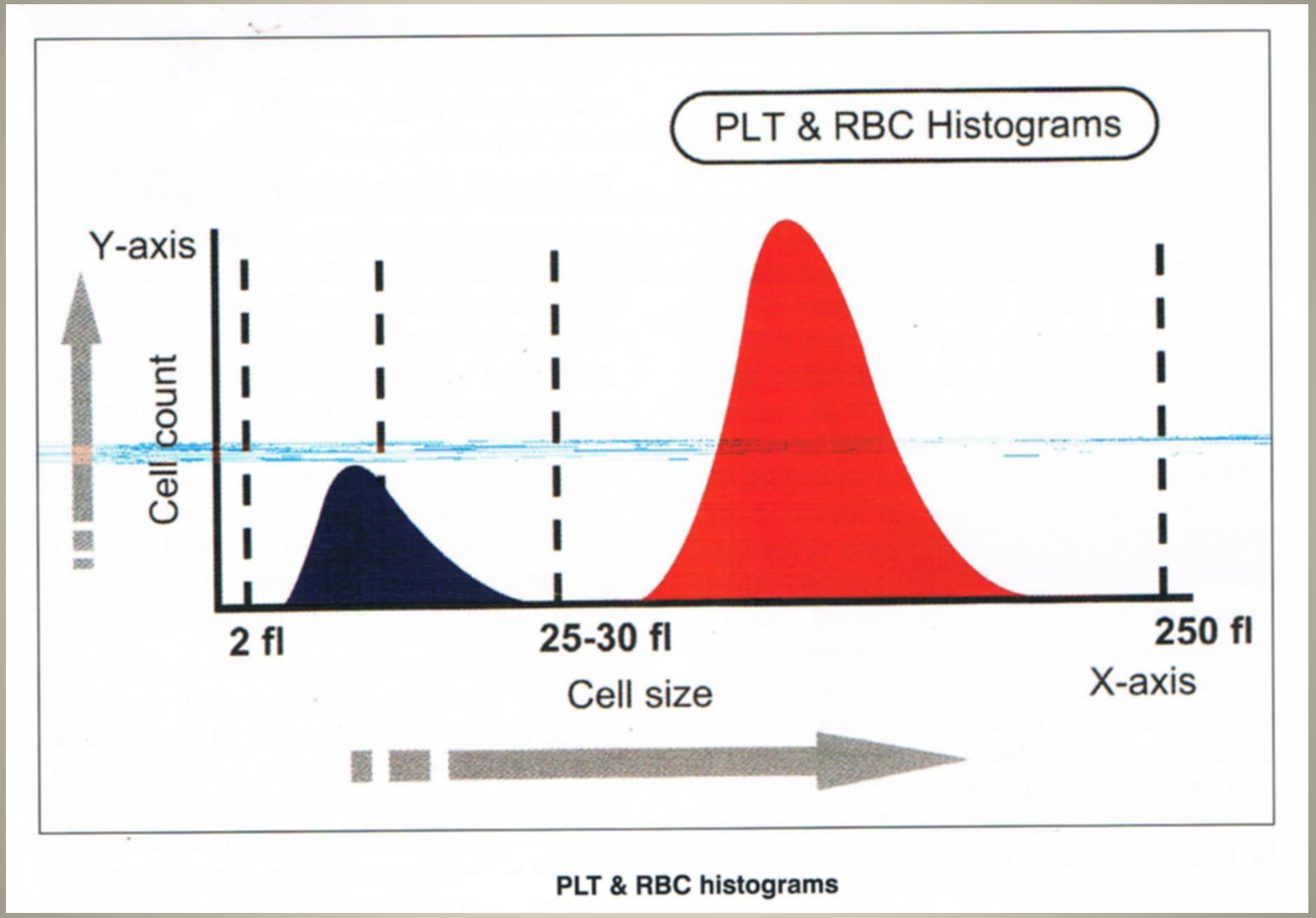
- Histograms are size distribution curves
- Graphical representation of numerical data about different cell populations
- Created for RBC, WBC and platelet populations
- Based on cell volume and relative cell number
- Allows visualization of:
  - Subpopulation of cells
  - Their average size in relation to the rest of the population
  - Their relative number



RBC HISTOGRAM



Components of RBC histogram



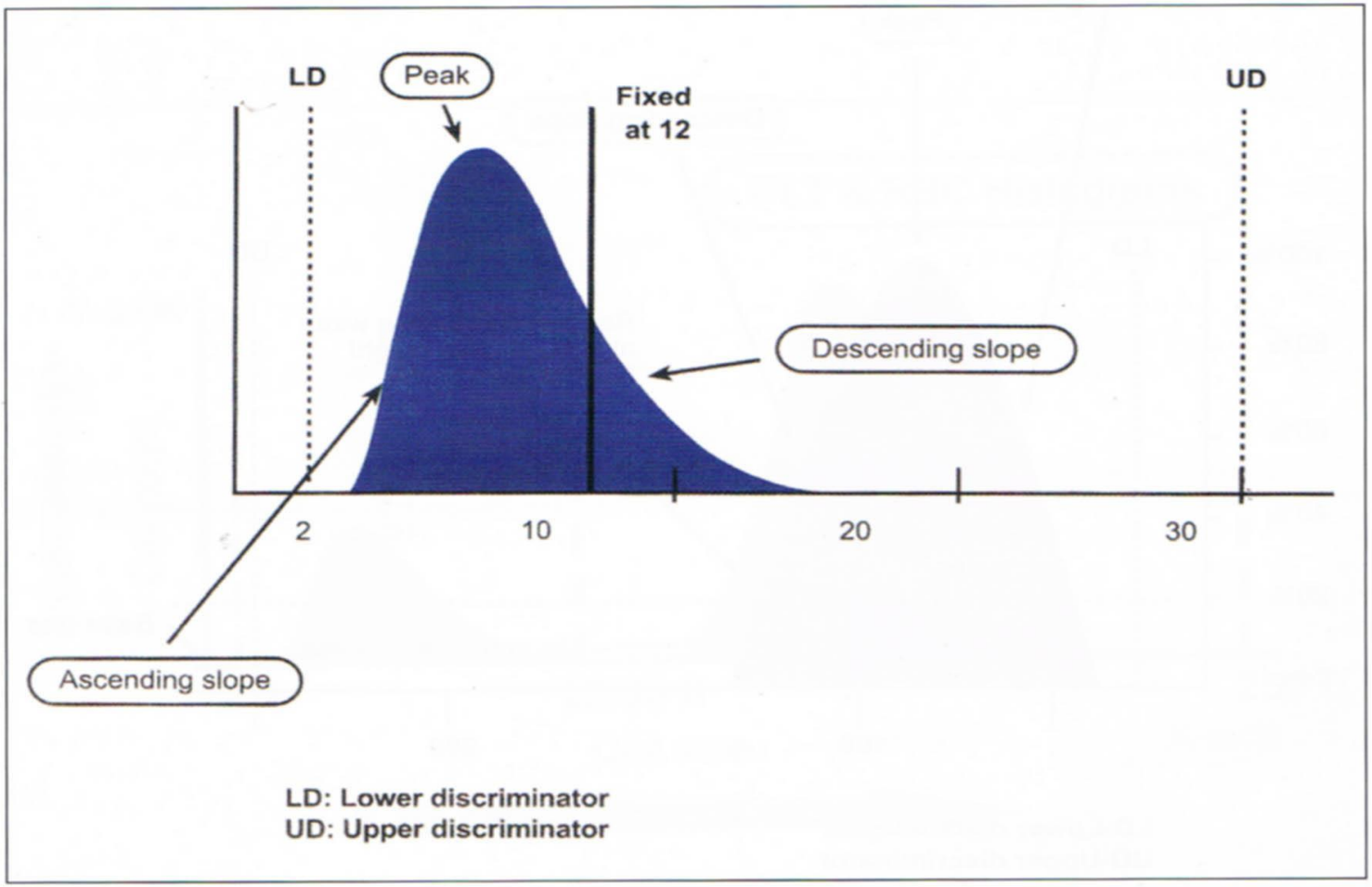
PLT & RBC histograms

RBC ALARMS

When MCV very low <55fl, RBC histogram may merge with PLT histogram- both RBC & PLT counts inaccurate

- **Falsely high RBC count: large PLTs, marked thrombocytosis, fragmented red cells.**
- **Falsely low RBC count: cold agglutinins, EDTA-dependent agglutination, RBC lysis d/t mishandling, extreme microcytosis**
- **Falsely high MCV: red cell agglutination, excess EDTA, EDTA-dependent agglutination or samples stored at room temp.**
- **Falsely low MCV: hypochromic RBC, severe anemia with marked thrombocytosis, increase in ambient temp.**

PLATELET HISTOGRAM

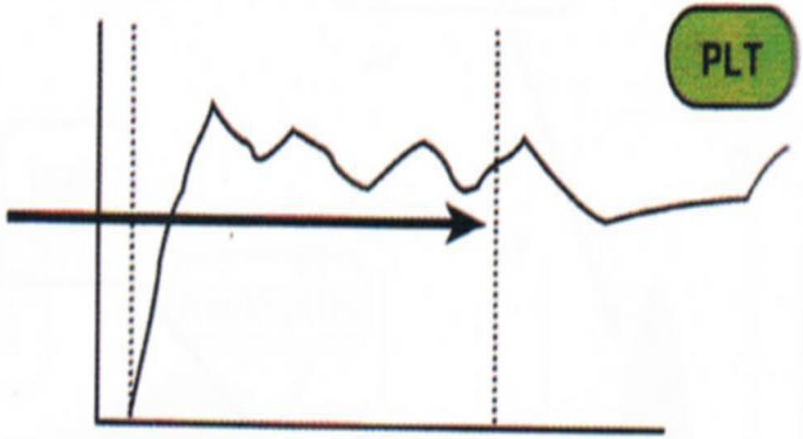


Histogram showing ascending slope, peak and descending slope

PLATELET ALARMS

- **Falsely high APC: microcytic RBCs, fragmented RBCs, HbH disease, cryoglobulin**
- **Falsely low APC: giant PLTs, PLT satellitism, EDTA-induced PLT agglutination, activation of PLT during venipuncture, partially clotted blood sample.**
- ***If PLT flag generated, Scan PBF***
- ***Verify PLT count manually***
- **MPV: 8-12 fl**
- **PDW at 20% of peak height, 9-14 fl**

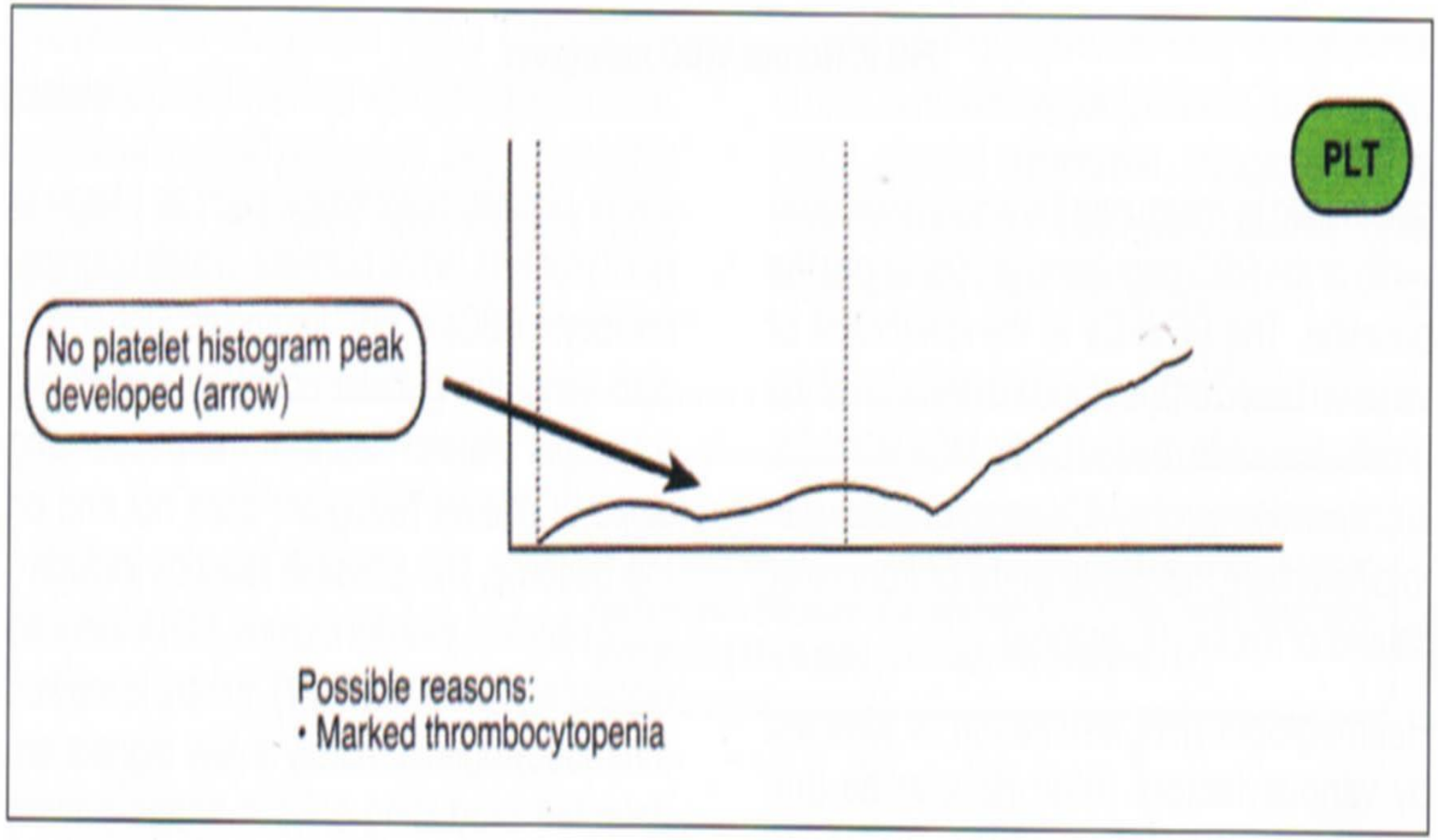
Descending slope of platelet histogram does not end on the baseline (arrow)



Possible reasons:

- EDTA induced platelet agglutination
- Giant platelets
- Platelet clumps

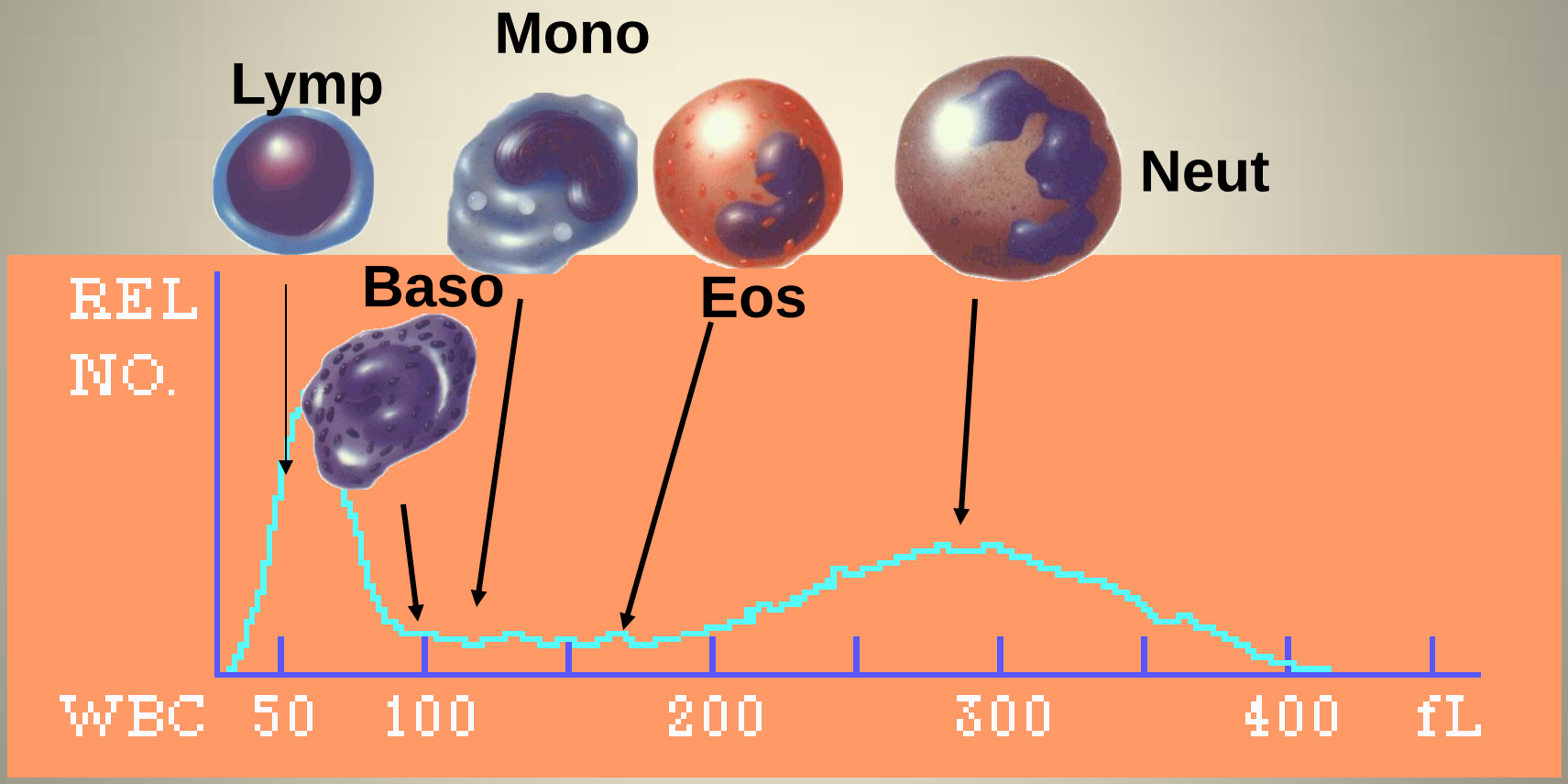
Platelet histogram: The descending slope is not ending on the baseline

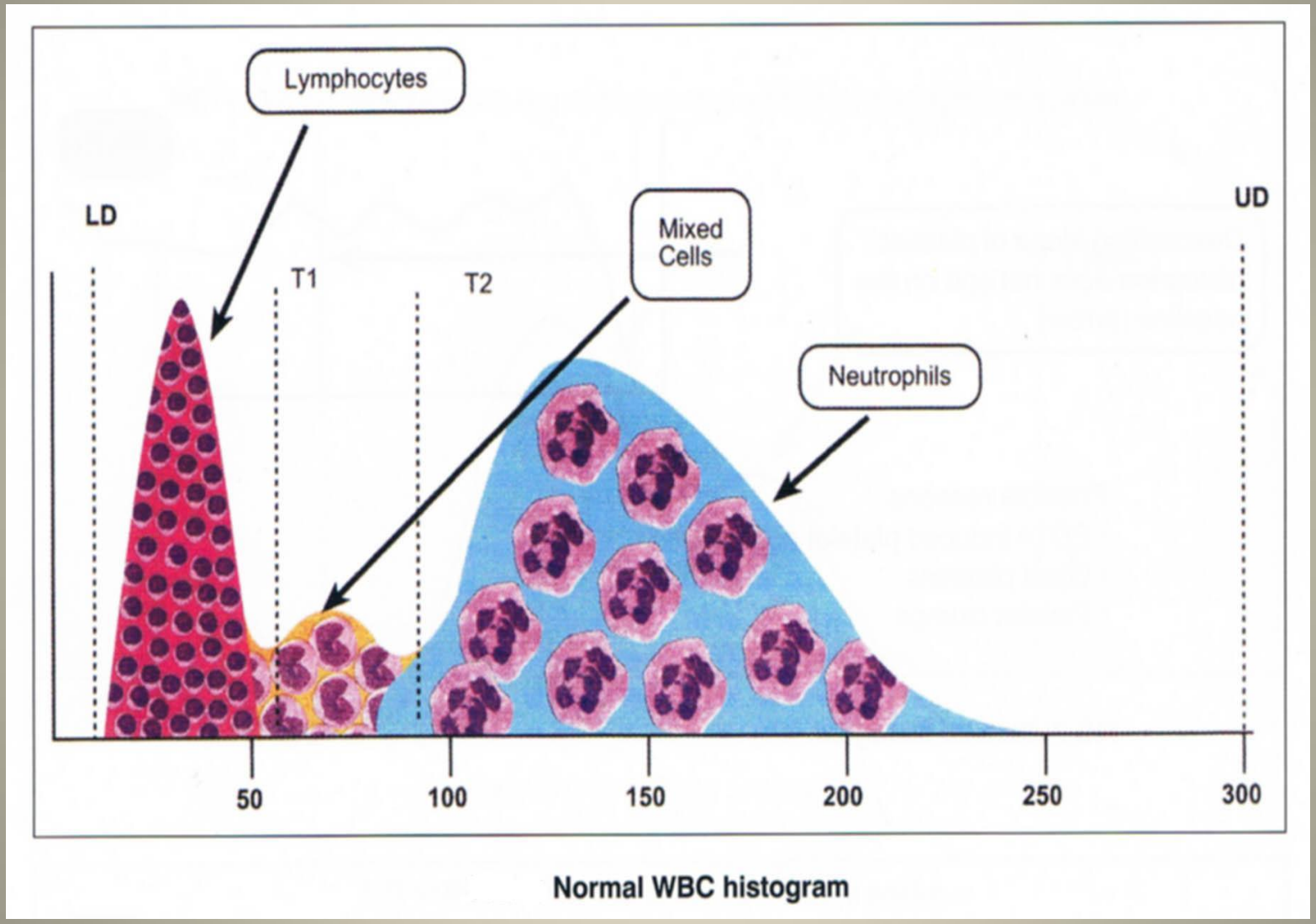


Platelet histogram in a patient with marked thrombocytopenia

WBC HISTOGRAM

WBC HISTOGRAM

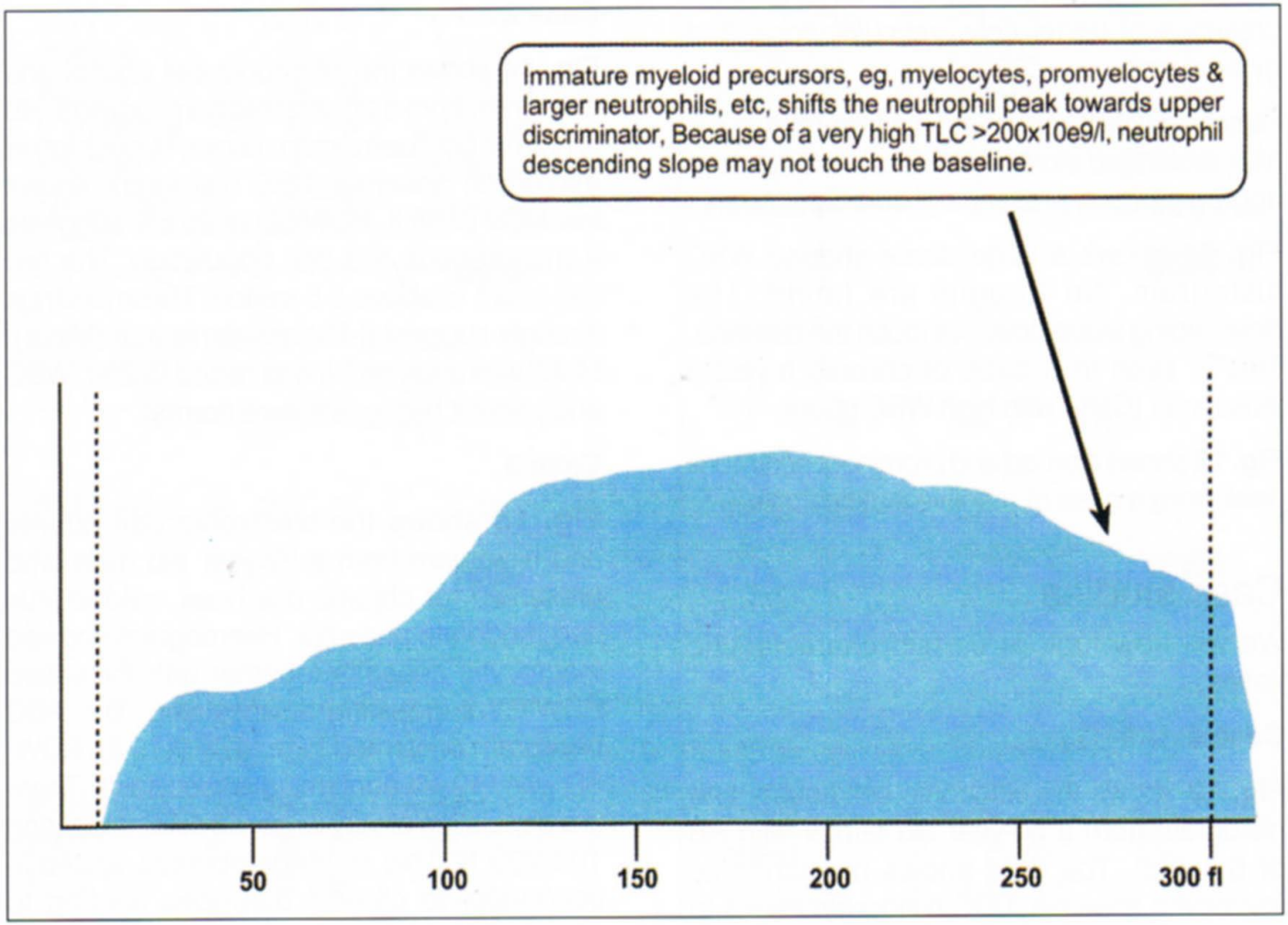




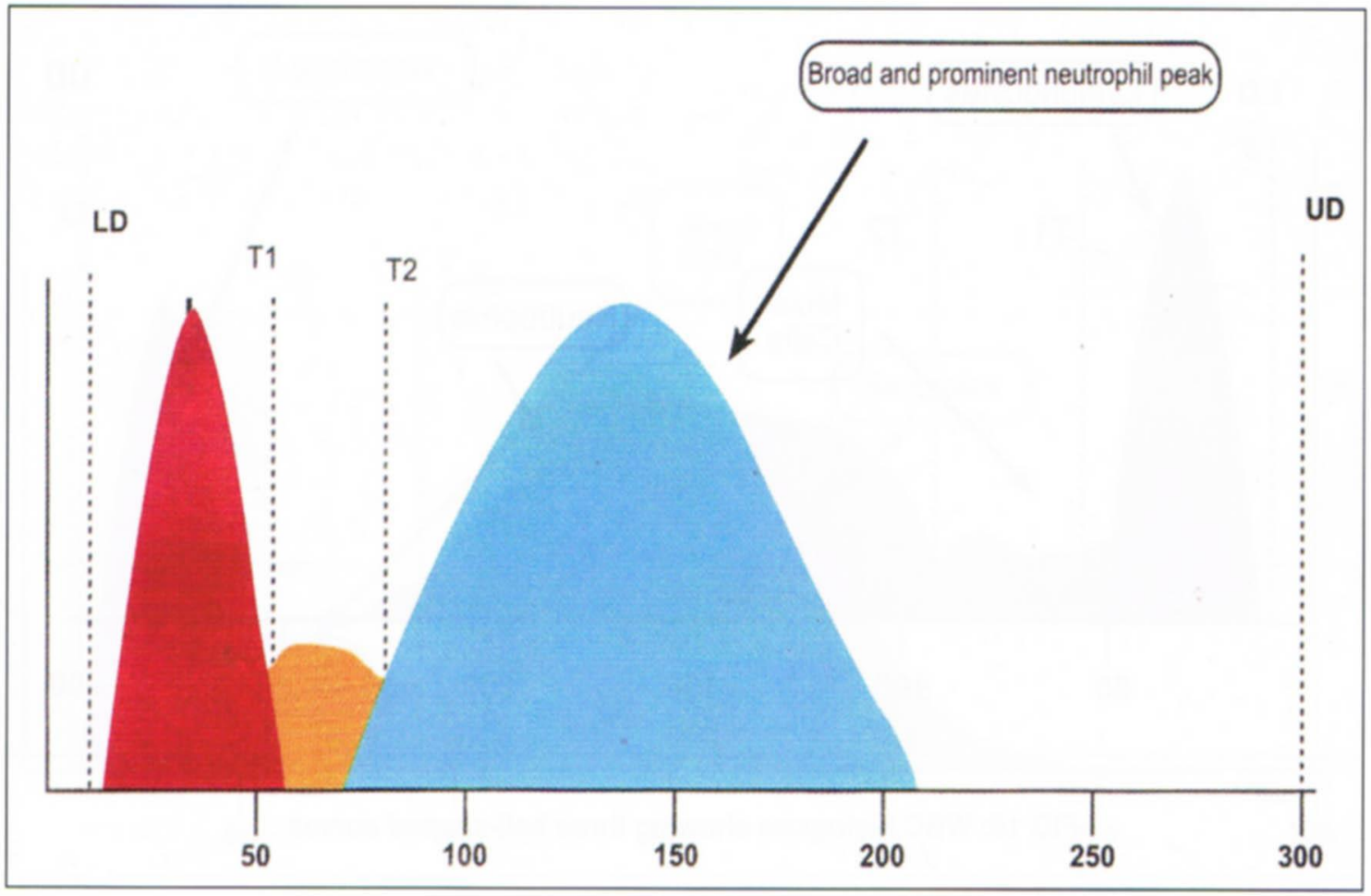
Normal WBC histogram

WBC HISTOGRAM: ALARMS

- Presence of NRBCs or PLT clumps interfere with lympho peak
- Immature myeloid precursors, large PMNs shift neuro peak towards UD
- Falsely high WBC count: NRBCs, giant PLT, lyse-resistant RBCs, PLT aggregates, malarial parasites, hyperlipidemia
- Falsely low WBC: WBC lysis after prolonged storage, WBC/PLT aggregates, cold agglutinins

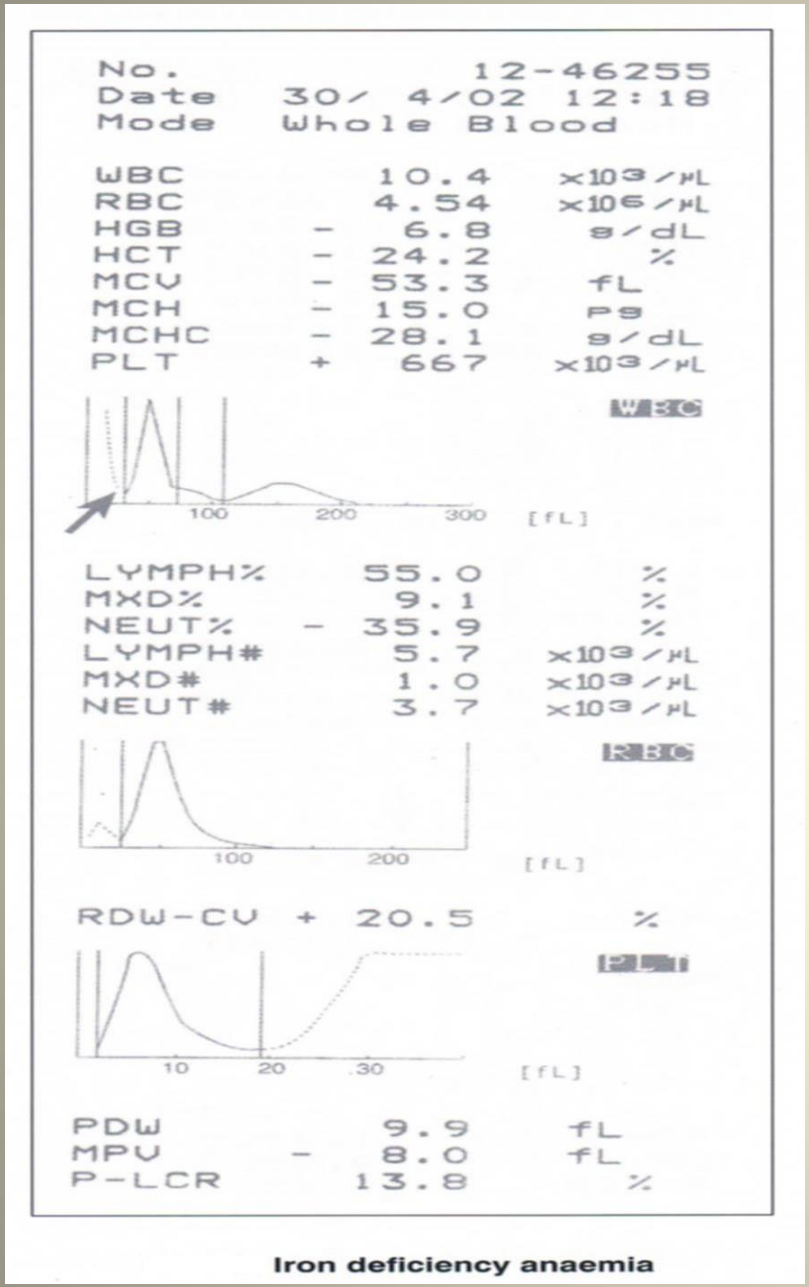


WBC histogram from a case of CML showing one large dome shaped curve without any troughs



WBC histogram from a case of reactive leukocytosis showing a broad and prominent neutrophil peak

INTERPRETATION OF CBC REPORTS IN CLINICAL SETTINGS



Iron deficiency anaemia

- 50 yr old man with marked pallor
- Microcytic hypochromic indices
- RBC histogram peaking to left, low MCV
- RDW-CV high s/o anisocytosis
- WBC & PLT histograms normal
- Diagnosis:IDA
- Confirmed by Iron studies
- Stool for occult blood

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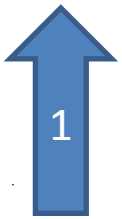

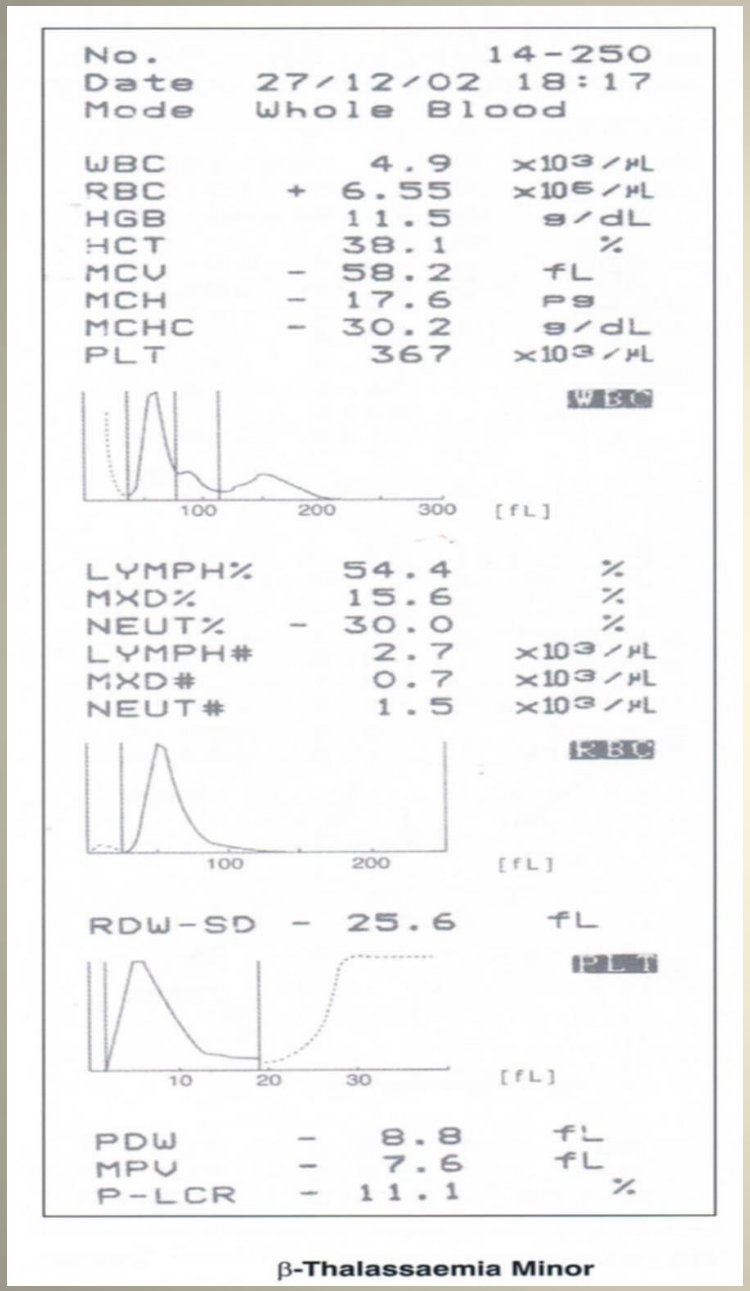

β-Thalassaemia Minor

- 20 yr old primi gravida
- Hb normal but microcytic hypochromic indices disproportionalely low
- Disproportionately high TRBC
- RDW-SD of 25.6 fl suggests a homogenous red cell population
- PS: uniform microcytosis
- HbA2 5.4%

CLASSIFICATION OF ANEMIAS BASED ON MCV & RDW

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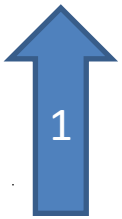

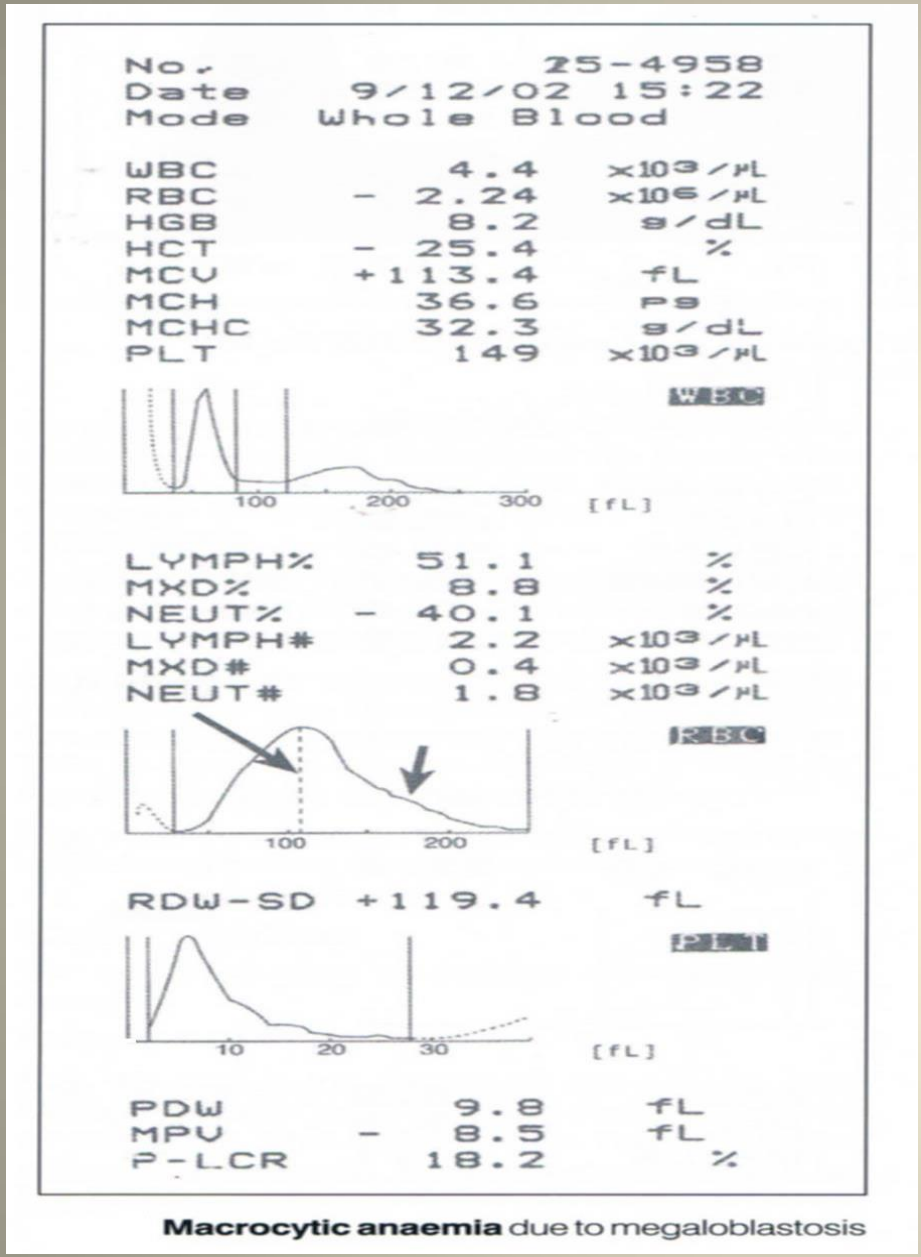

Macrocytic anaemia due to megaloblastosis

- Young male with mild icterus, moderate anemia
- Macrocytic anemia with high RDW
- Shift of RBC histogram to right- population of very large red cells 150-200 fl
- Serum B12 & RBC folate

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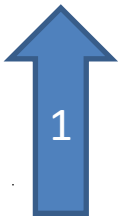

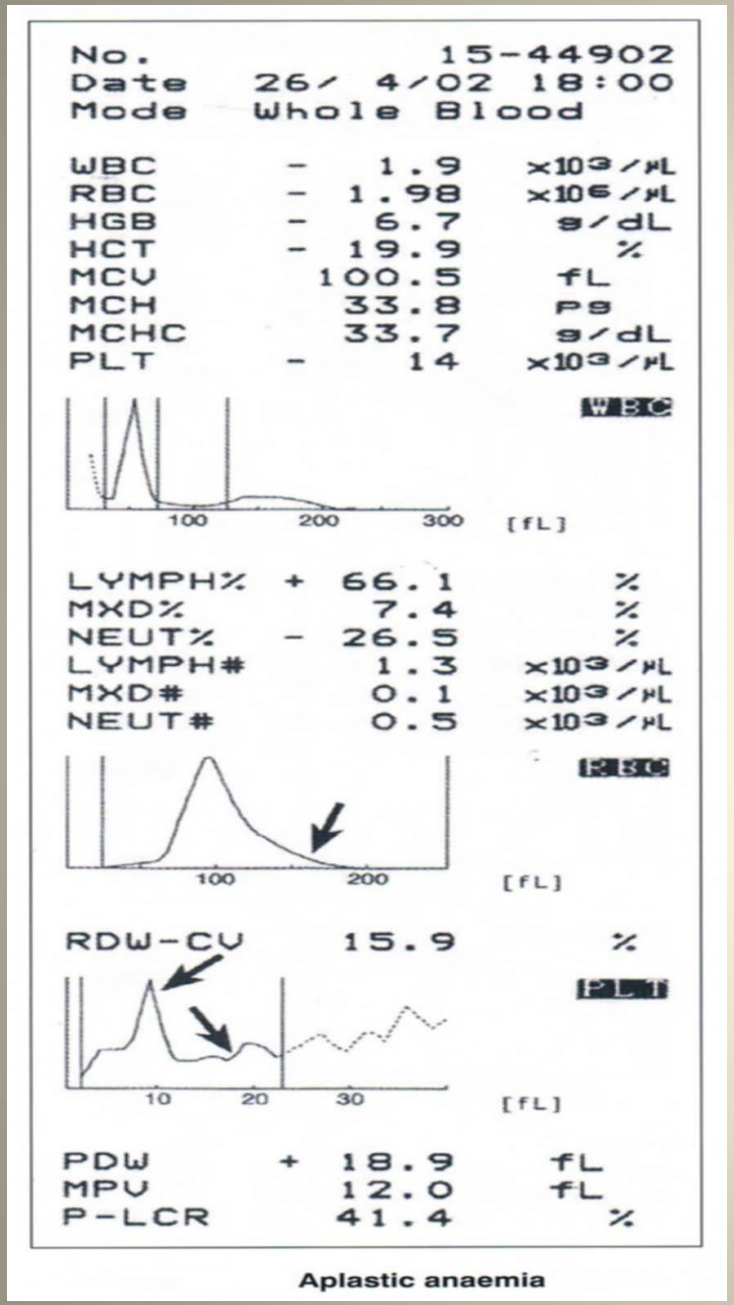

Aplastic anaemia

- 12 yr old boy with purpura, marked pallor, fever
- Pancytopenia
- MCV 100.5, RDW 15.9%
- RBC histogram skewed to right
- WBC histogram: lymphocyte peak, faint dome of neutrophils
- PLT histogram- abn shape,descending slope not touching baseline
- BM Bx confirmed AA

CLASSIFICATION OF ANEMIAS BASED ON MCV & RDW

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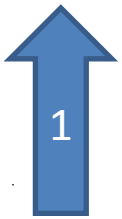


Anemia is not yet apparent

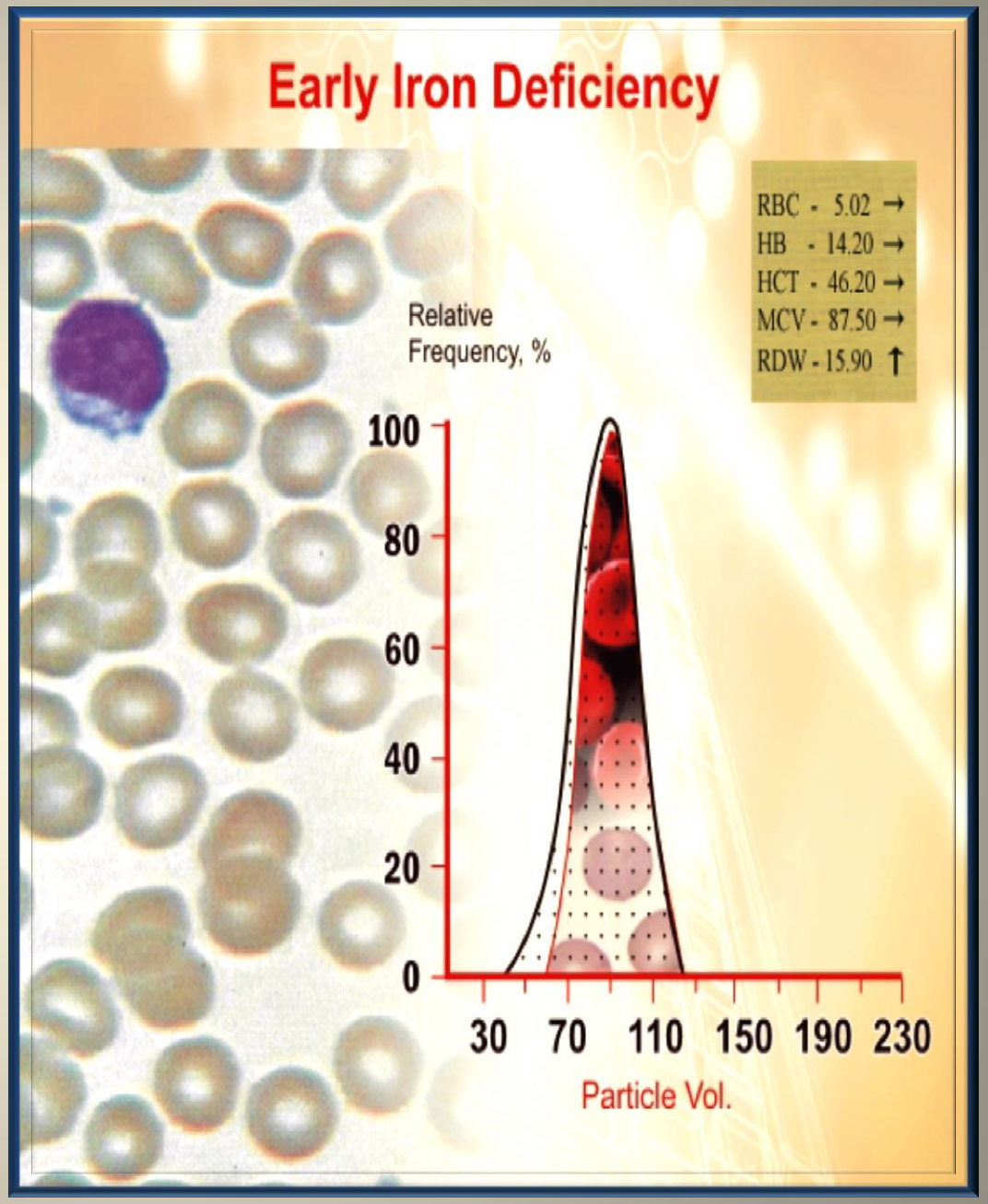
MCV still is in the normal range and Peripheral Smear shows mild Anisocytosis

BUT

RDW is increased (Earliest Indicator)

Histogram is Unimodal but is wider

Increased RDW combined with normal RBC values (MCV , Hb , Hct) distinguishes Iron deficiency from Normal Subjects

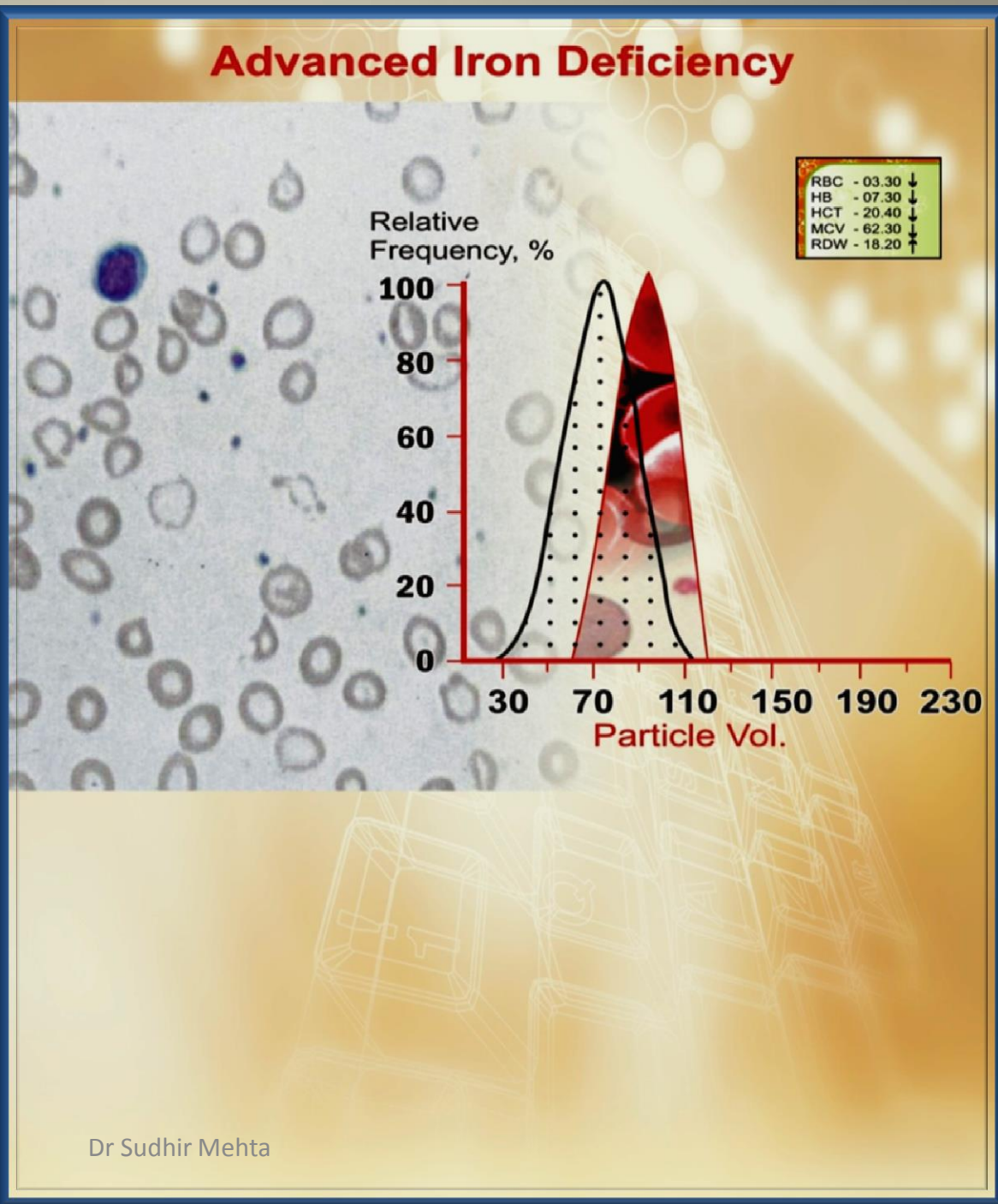


Anemia is present, MCV is very low, and the smear is very abnormal

RDW is abnormally high;

Histogram remains abnormal.

The diagnosis is easily made at this point, but earlier identification would improve management



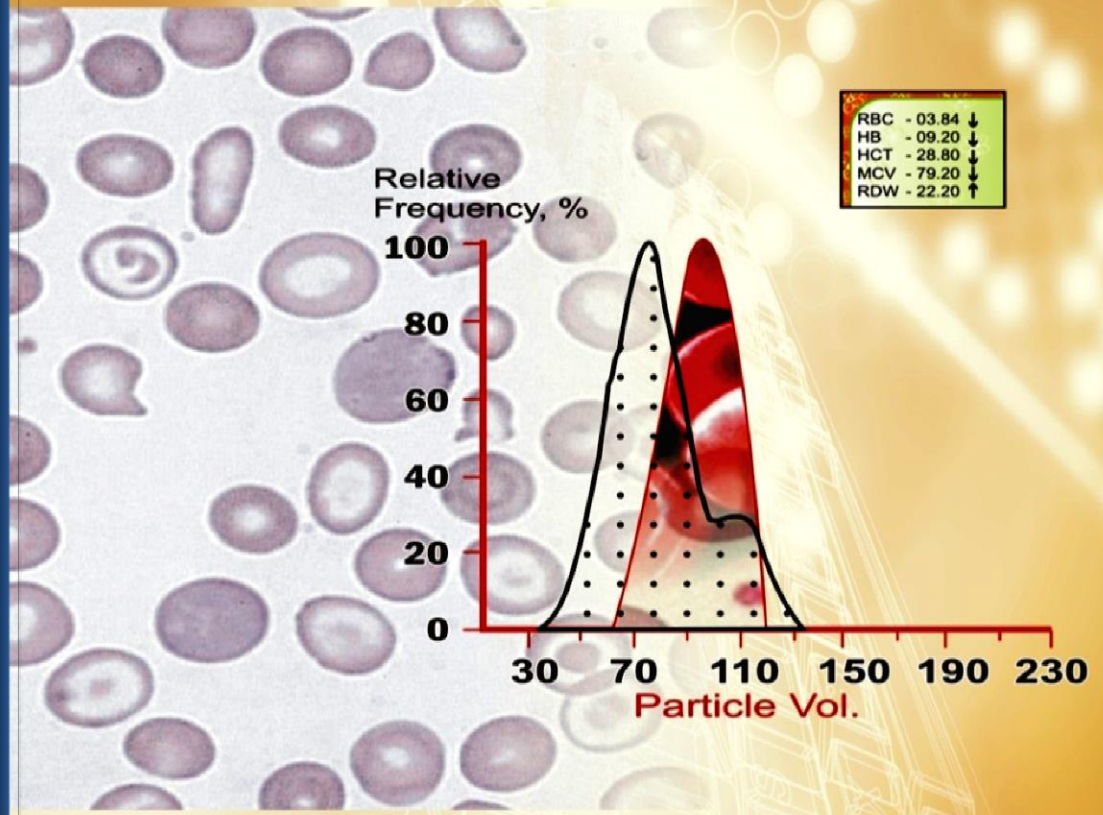
The red cell count is increasing,

MCV is not yet normal, and

Two populations of red cells are seen-preexisting microcytes, and newly formed normocytes.

***The two populations are distinguished easily on the red cell histogram but not so easily on the peripheral blood smear*.**

Recovery from Iron Deficiency



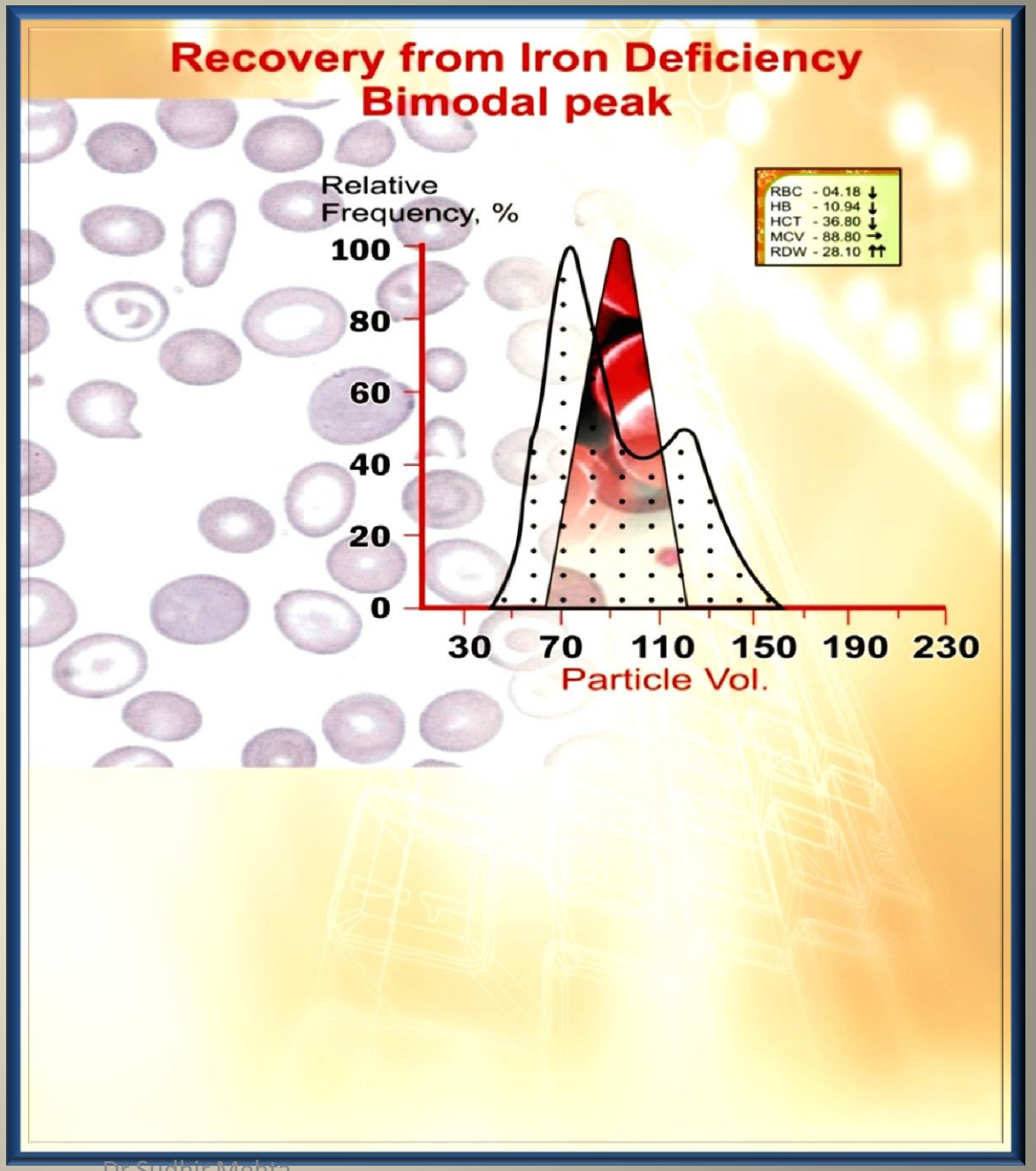
In contrast to earlier figure, in this case, the new cells are macrocytic.

Note the right peak has a mean value of 117 fl.

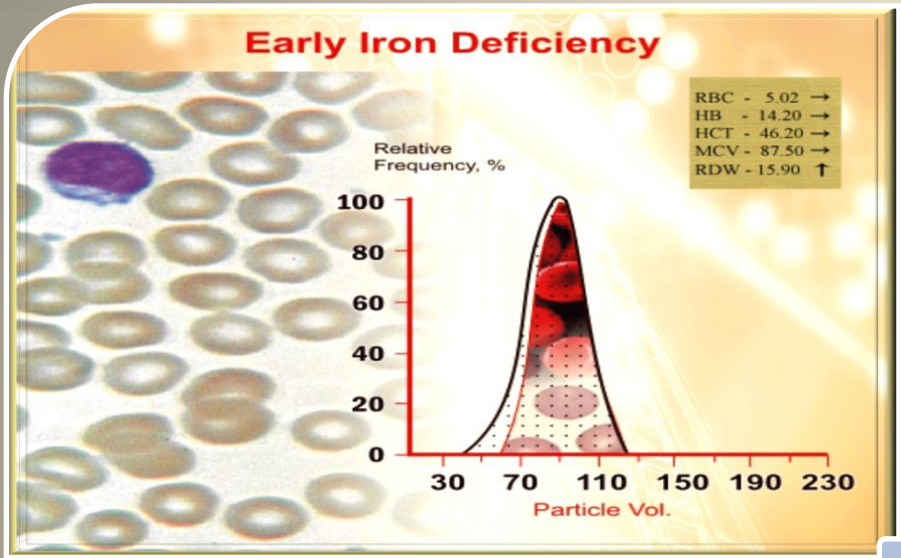
This macrocytic response indicates an unmasked underlying macrocytic disorder.

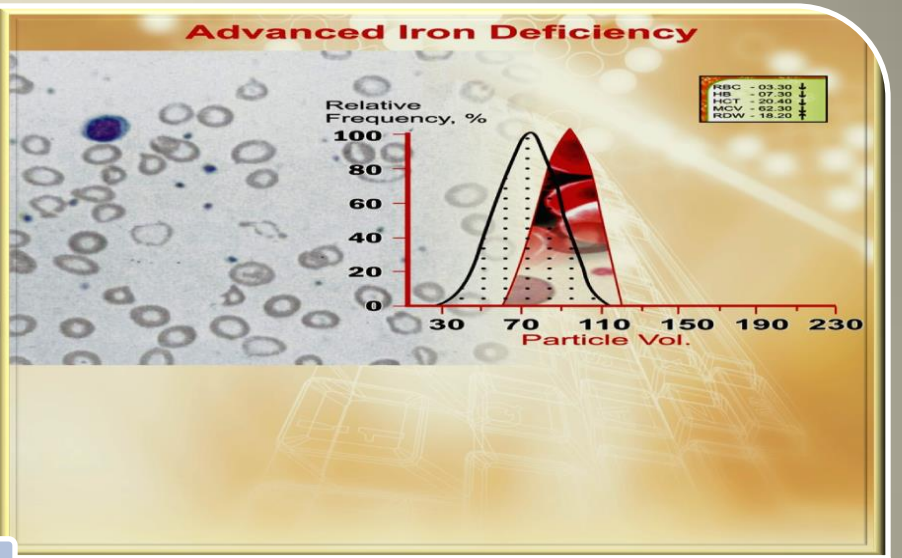
Use of the histogram allows this analysis even though the MCV is only 86.8fl.

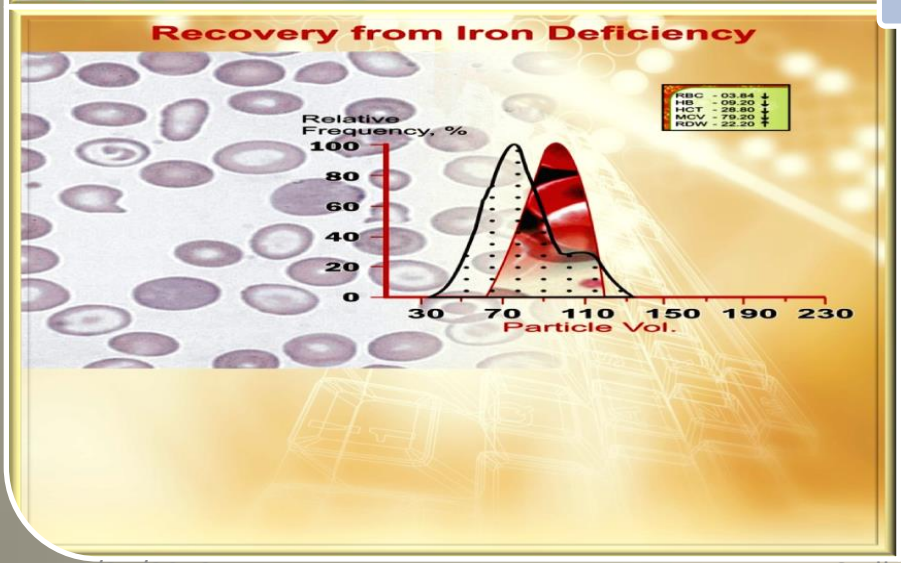
The two populations cannot be well distinguished from the blood smear.

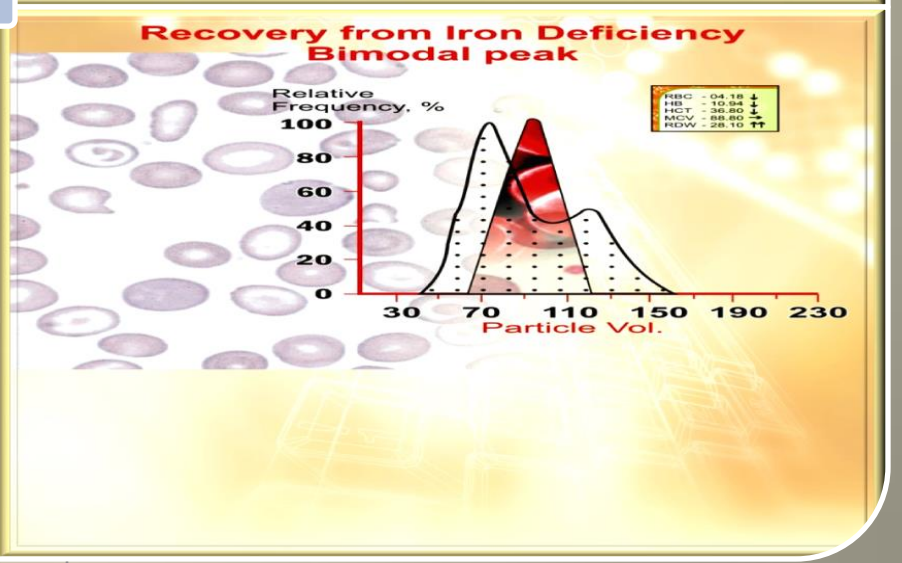


IRON DEFICIENCY ANAEMIA







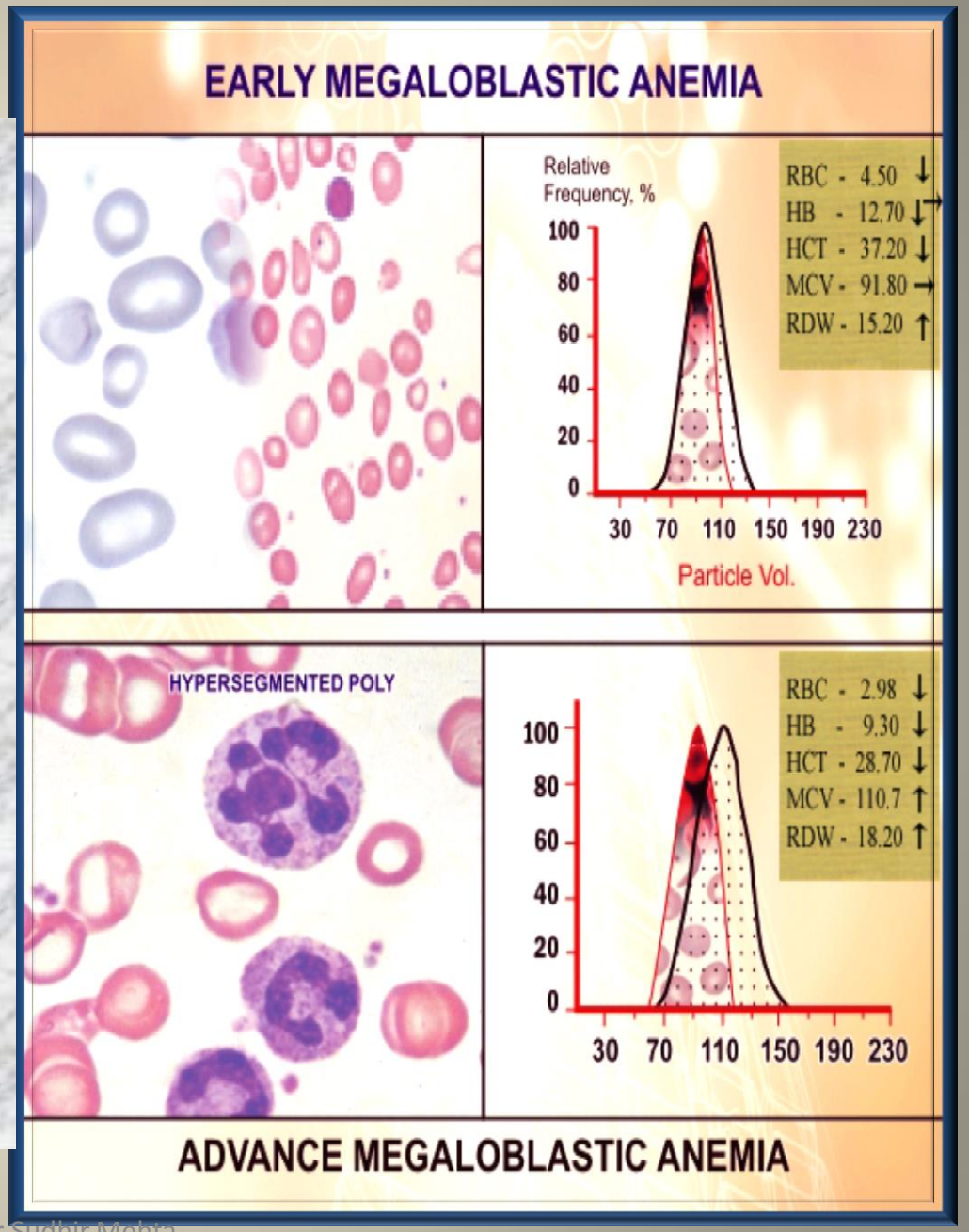


EARLY FOLATE DEFICIENCY-

- The MCV is still normal RBC count and Hb slightly reduced but
- RDW is clearly increased , even before apparent anemia.

SEVERE FOLATE DEFICIENCY –

- RBC Count is low.
- MCV is high.
- RDW is increased



Normocytic recovery

a small peak of cells in the normal range

• RDW is higher than untreated megaloblastic anemia due to two cell population contributing to the heterogeneity.

Microcytic recovery

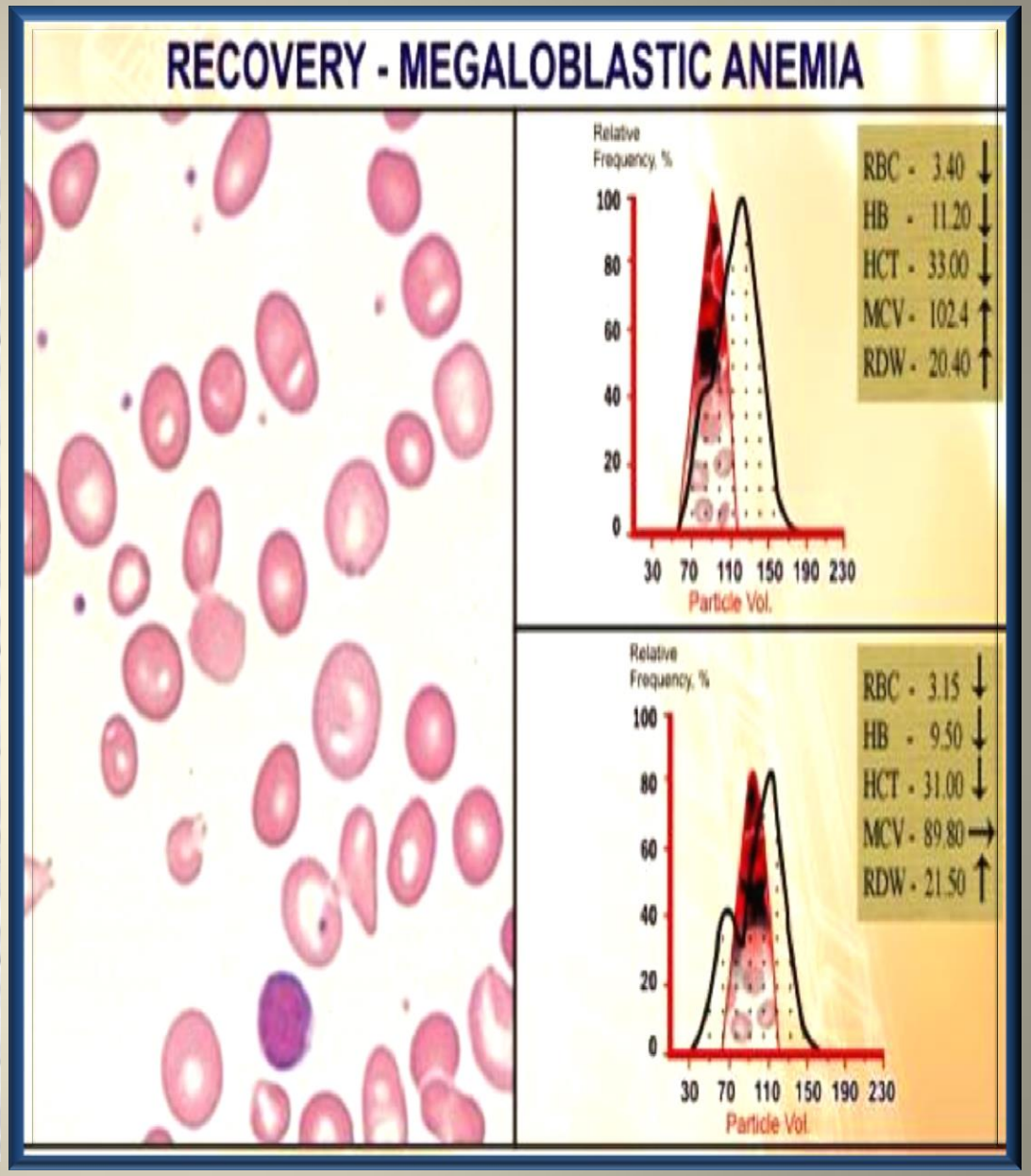
Two Cell population is clearly seen in this histogram – old macrocytes and newly produced microcytes .

Concomitant iron deficiency has been unmasked.

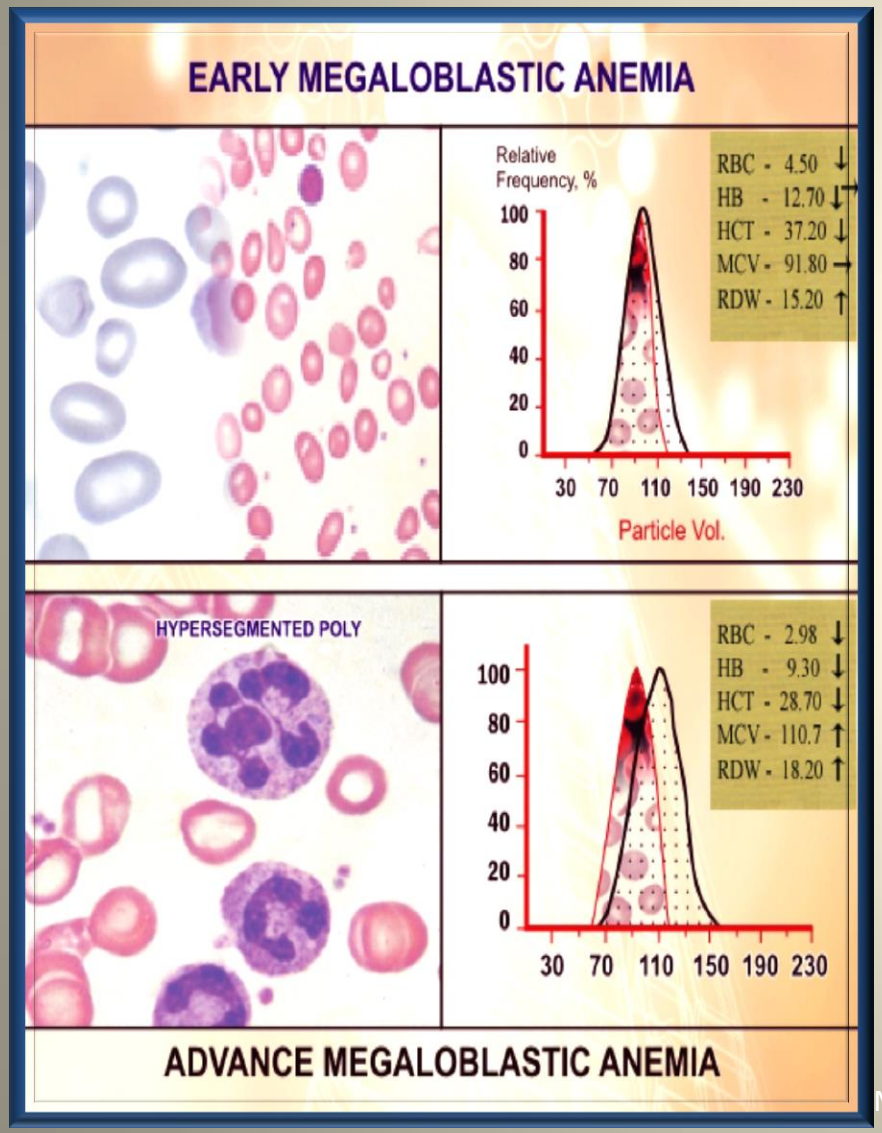
RDW is markedly increased..

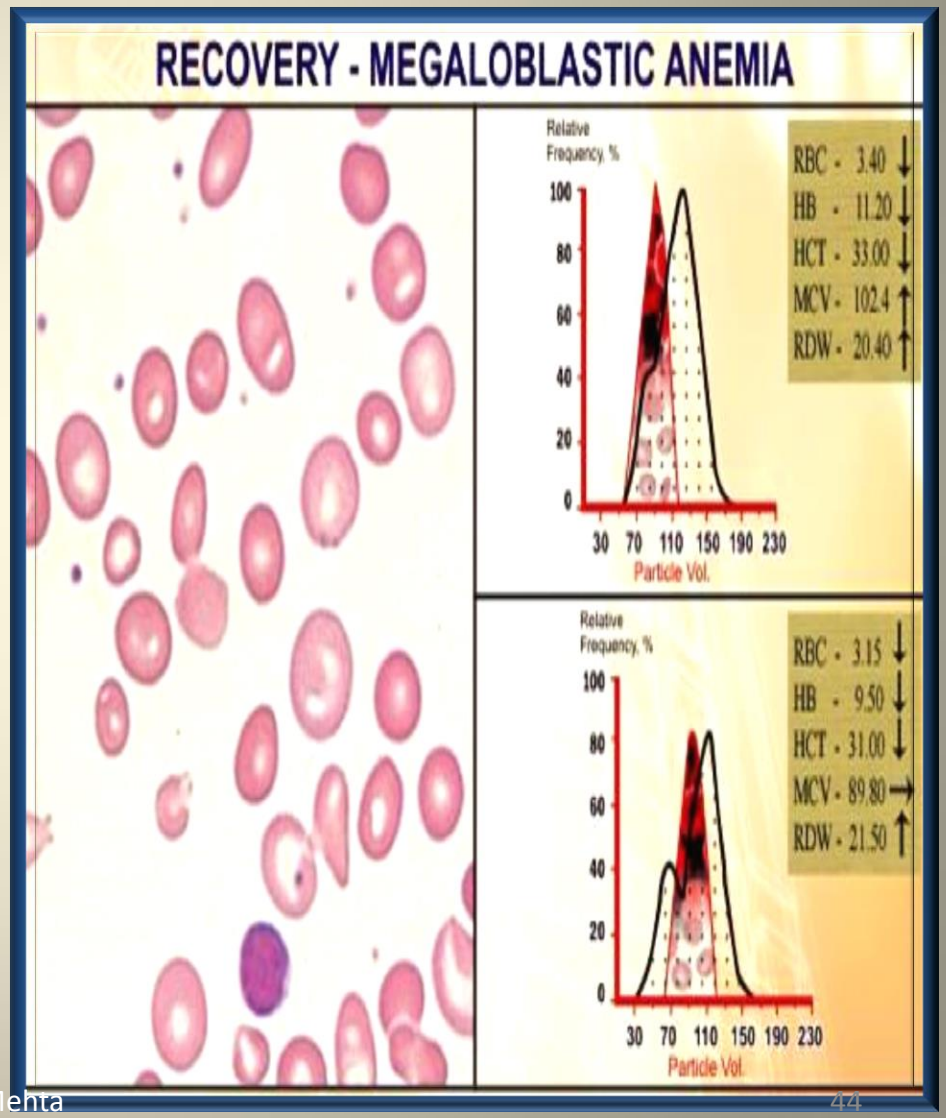
MCV is normal only because it reflects the average of two abnormal populations

There is no population of RBC with normal MCV



MEGALOBLASTIC ANEMIA





CARRY HOME MESSAGE

- **Graphics generated by hematology analyzers are a neglected piece of information; until recently, very little emphasis has been given to the graphs**
- **Often information generated by hematology analyzers in form of numerics & graphs is available at the time of initial consultation & hence becomes a guiding force in making the initial diagnosis and in planning further investigations**
- **Numerical data & graphs and manual exam of blood smear are complementary to each other in hematological work-up**

"Okay your father
managed to get a mouse.
Now how do we use it?"

ORGANIZING COMMITTEE

PATRONS

- **Prof Subhash Nepalia**
  Principal & Controller
  SMS Medical College & Attached Hospitals
- **Prof S R Mehta**
  Emeritus Professor of Medicine
  Chairman, Four Decade Trust

ORGANIZING CHAIRPERSONS

- **Prof C L Nawal**
  Chief of Medicine
- **Prof Hemant Malhotra**
  Chief of Medical Oncology
- **Prof Ajay Yadav**
  Chief of Pathology
- **Dr V D Maheshwari**
  Chairman, Jaipur Chapter of API

PROGRAM DIRECTOR

- **Prof Sudhir Mehta**

PROGRAM CO-DIRECTORS

- **Dr Upendra Sharma**
- **Dr Seema Mehta**
- **Dr Sandhya Gulati**
- **Dr Nidhi Sharma**

REGISTRATION DETAILS

- **Registration Fee : Rs 300/-** only payable by **Cash/Demand Draft** in favor of **"SMS Medical College Four Decade Trust, Jaipur"** (No cheques will be entertained)
- Duly filled Registration Form (enclosed herewith) along with registration fee (by demand draft/cash) should reach the Program Director on or before 8th February, 2014
- Registration fee is **non-refundable.**
- All registrations after 8th February 2014 will be treated as spot registration. **On-spot registration fee is Rs 600/- subject to availability of seats.**

Last Date for submission of duly filled Registration Form
Saturday, 8th February, 2014

ADDRESS FOR ALL CORRESPONDENCE & SUBSCRIPTION :

Dr Sudhir Mehta
Program Director
5th Regional CME in Haematology
16 Ganesh Colony, Opposite Soni Hospital, JLN Marg, Jaipur-302004
Tel : 0141-2620710 • Mobile : 094140-42033
Email : s.smehta@hotmail.com

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5th Regional

CME IN HAEMATOLOGY 2014

Sunday, 16th February , 2014

Venue : Shri Mahaveer Digamber Jain School Auditorium
Mahaveer Marg, 'C' Scheme, Jaipur

UNDER THE AUSPICES OF

- SMS MEDICAL COLLEGE FOUR DECADE TRUST
- DEPARTMENT OF MEDICINE, SMS MEDICAL COLLEGE
- DEPARTMENT OF PATHOLOGY, SMS MEDICAL COLLEGE
- JAIPUR CHAPTER OF API

Invitation

Dear Friends,

It is our pleasure & privilege to invite you all to the 5th Regional CME in Haematology being organized under the auspices of SMS Medical College Four Decade Trust. Departments of Medicine & Pathology, SMS Medical College & Jaipur Chapter of Association of Physicians of India. With each passing year, this CME is growing & making its presence felt in neighboring states and in North India. All this has been possible due to your enthusiasm & support.

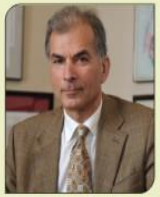
The biggest & most precious catch of this CME is the world renowned hematologist. Dr. Near Young. He is not unknown to those who have passion for hematology. Dr. Young is the Chief of the Haematology branch of the National Heart, Lung & Blood Institute and Director of the Trans-NIH Centre for Human Immunology, Auto-immunity & Inflammation, Bethesda, Maryland. The national faculty includes stalwarts in the field of Haematology- Dr M B Agarwal, Dr R Manchanda, Dr Pritesh Junagade & Dr Pankhi Dutta. We are making great efforts in offering you a high-quality scientific program and the opportunity to interact one-to-one with the invited faculty. The selected topics are of immense interest and everyday relevance to physicians, pediatricians, pathologists & gynecologists.

Wishing you all a very happy & prosperous New Year 2014

Dr C L Nawal | **Dr Hemant Malhotra** | **Dr Ajay Yadav**

Dr V D Maheshwari | **Dr Sudhir Mehta**

FACULTY


Dr Neal Young (USA)

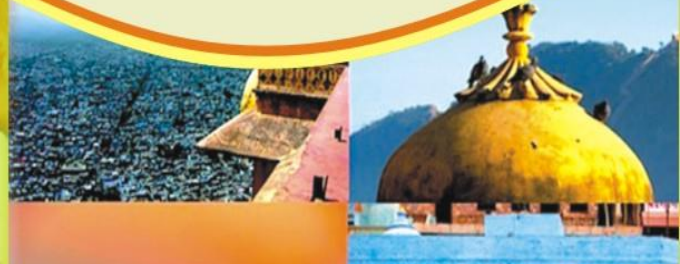
Dr M B Agarwal

Dr R Manchanda

Dr Pankhi Dutta

Dr Pritesh Junagade

PROPOSED TOPICS

- ABC of CBC (Case-based)
- Interpreting Lab data in anemia (panel discussion)
- Life without platelets
- XYZ of coagulation
- Approach to evidence management of DVT
- Role of Haematologist in PUO
- Advances in understanding & treating aplastic anemia
- Antiphospholipid syndrome-then & now
- PS-a picture speaks thousand words
- Intricacies in lab diagnosis of lupus anticoagulants
- Role of bone marrow trephine biopsy in benign haematology (case-based)

LAST DATE FOR SUBMISSION OF DULY FILLED REGISTRATION FORM
SATURDAY, 8TH FEBRUARY 2014