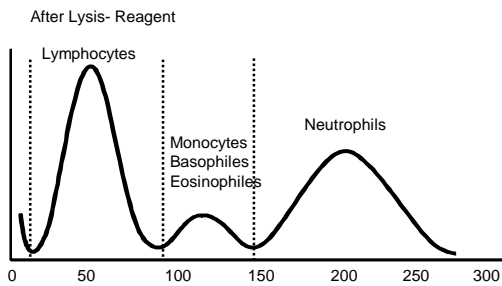
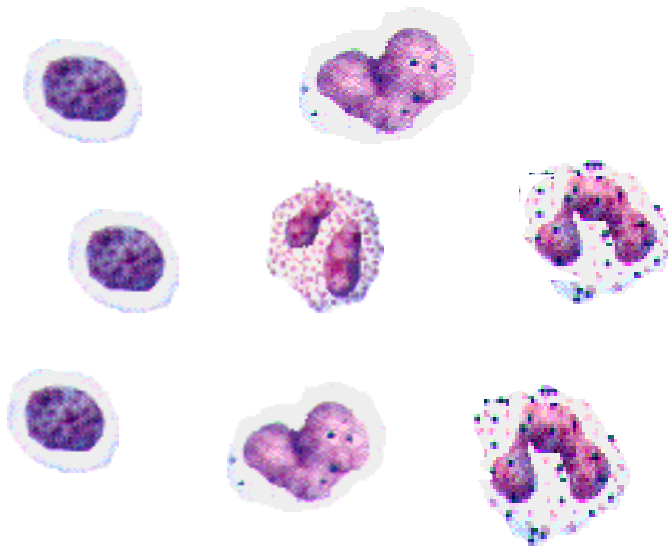
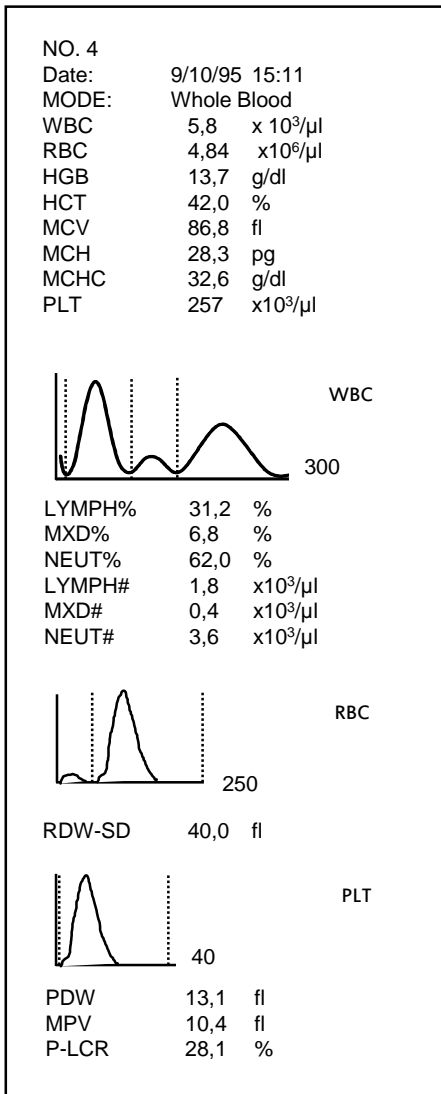


# Histogram Interpretation



# K-Series: Histogram Interpretation

## Normal Result



### Parameter of CBC

### Leucocyte Histogram

- Lymphocytes in % and absolut
- Eo, Mono, Baso in % and absolut
- Neutrophils in % and absolut

### Erythrocyte - Histogram

- RBC Distribution Curve

### Thrombocyte Histogram

- PLT Distribution Curve
- Mean PLT Volume
- Share of bigger PLT

# K-Series: Histogram Interpretation

## Normal Ranges

### White Blood Cell Count

Parameter	Age	Units	SI-Units
WBC	Adults	4-10 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
	Childs	till 12 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
	Newborns	till 15 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
Lymph.	Adults	25-40 %	
	Childs, Newborns	till 70 %	
MXD	Adults	3-13 %	
Neutro.	Adults	50-70 %	
Lymph.	Adults	1-4 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
	Childs	till 5 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
	Newborns	till 6 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
MXD	Adults	0,2-1 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
Neutro.	Adults	2-7 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l

### Red Blood Cell Count

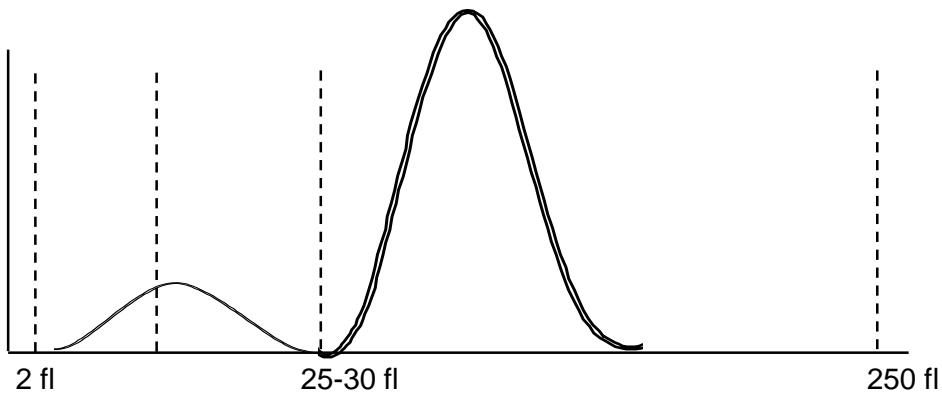
Parameter	Age	Units	SI-Units
RBC	Men	4,6-6,2 x 10 <sup>6</sup> /μl	x 10 <sup>12</sup> /l
	Women	4,2-5,4 x 10 <sup>6</sup> /μl	x 10 <sup>12</sup> /l
HGB	Men	14-18 g/dl	8,5-11,0 mmol/l
	Women	12-16 g/dl	7,5-10,0 mmol/l
HCT	Men	43-49 %	0,43-0,49 mmol/l
	Women	36-46 %	0,36-0,46 mmol/l
MCV		85-95 fl	
MCH		27-33 pg	1,68-2,05 fmol
MCHC		32-36 g/dl	19,9-22,4 mmol/l
RDW-SD		37-46 fl (Width in 20% of the Peak height)	
RDW-CV		11-16 % (calc. width of the 68 % Peak height)	

### Thrombocytes

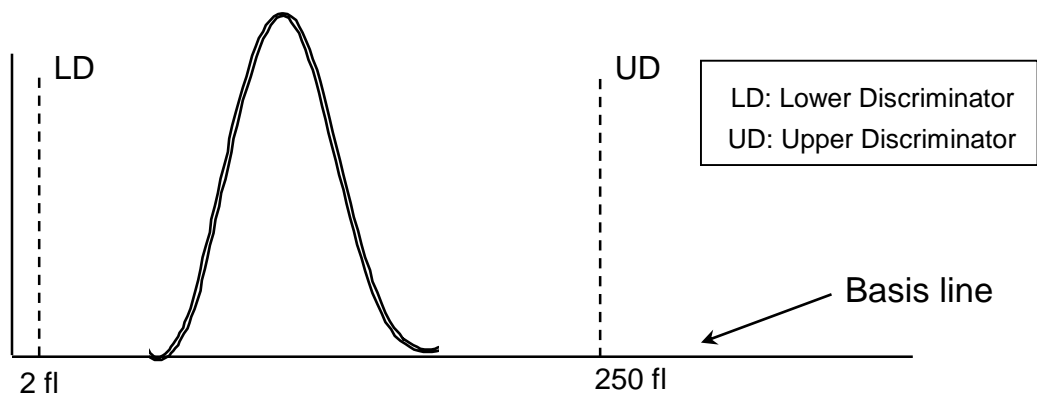
Parameter	Age	Units	SI-Units
PLT		150-400 x 10 <sup>3</sup> /μl	x 10 <sup>9</sup> /l
PDW		9-14 fl (Width in 20% of the Peak height)	
MPV		8-12 fl	
P-LCR		15-35 %	

# K-Series: Histogram Interpretation

## RBC- and PLT-Histograms



- The two distribution curves are separated from each other by a moving auto discriminator looking to the Plateau.
- Platelets have a size between 8 and 12 fl and are counted between 2 and 30 fl.
- Erythrocytes have a size of 80-100 fl and are counted between 25 and 250 fl.



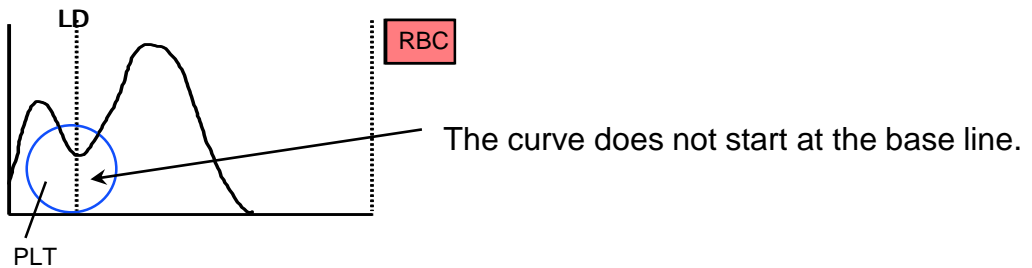
- The Size Distribution Curve should always start on the base line and fall between the lower and the upper discriminator.

# K-Series: Histogram Interpretation

## Erythrocyte-Histogram

## Flagging

Mark "RL", abnormal height at lower discriminator



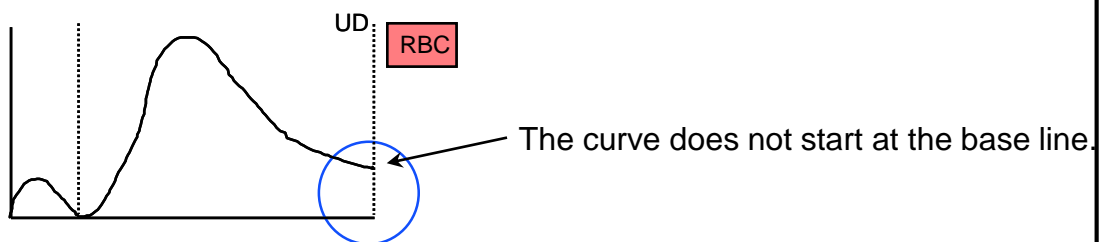
### Possible causes:

- Giant Platelets
- Micro-Erythrocytes
- Platelet Clumps

### Caution:

All results marked with "RL" should be controlled.

Mark "RU", abnormal height at the upper discriminator.



### Possible causes:

- Cold Agglutinins (check MCHC > 40 g/dl)
- Erythroblasts / Normoblasts

### Caution :

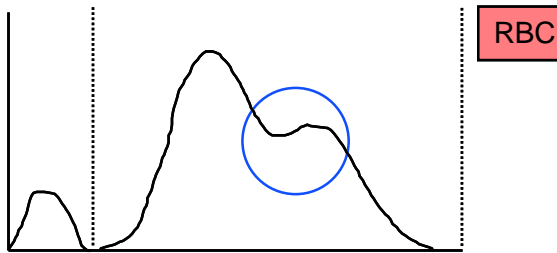
RBC-result and all results marked with "RL" should be controlled.

# K-Series: Histogram Interpretation

## Erythrocyte-Histogram

## Flagging

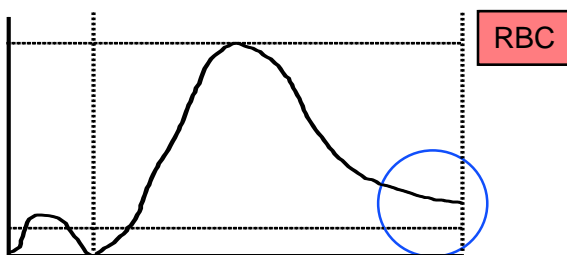
“MP”, multiple peaks found



Possible causes:

- Iron deficiency in therapy
- Infection or Tumor Anemia (visceral iron deficiency)
- Transfusions

“DW”, abnormal histogram distribution



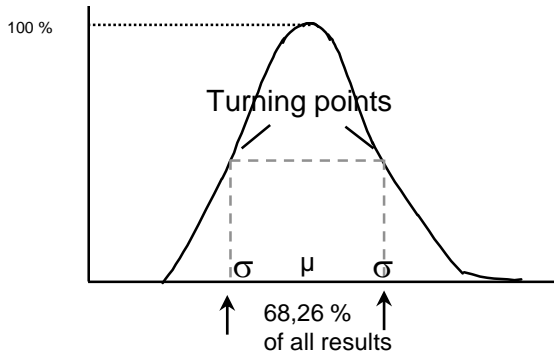
- Distribution curve does not cross 20% level twice.
- The overall height of the curve is always 100 %. The width is calculated on the 20 % height of the curve.
- Hint for extreme Aniso- or. Poikilocytosis.

# K-Series: Histogram Interpretation

## Erythrocyte-Histogram

## Distribution width

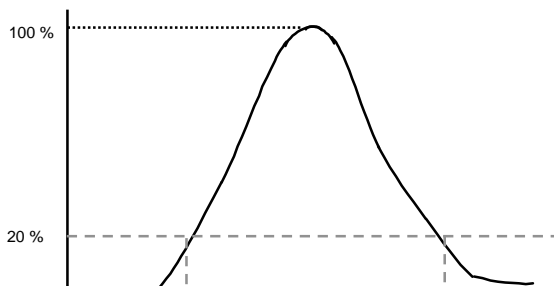
### RDW-CV



$$\text{RDW-CV (\%)} = 100 \times \sigma/\mu$$

$$\text{RDW-CV} = 11 - 16 \%$$

### RDW-SD



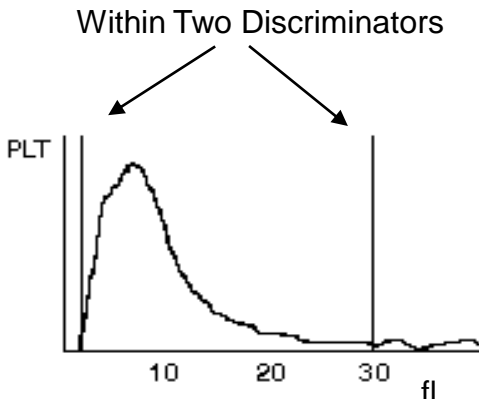
$$\text{RDW-SD} = 37 - 46 \text{ fl}$$

Clinical relevant > 60 fl

RBC Distribution Curve as a parameter for anisocytosis

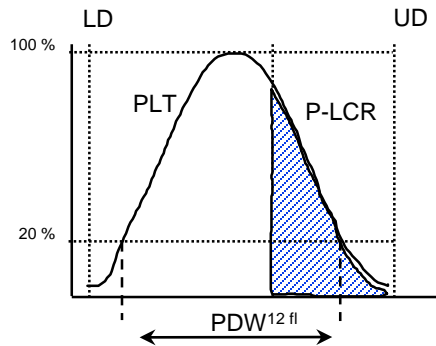
# K-Series: Histogram Interpretation

## Thrombocyte-Histogram



- The histogram should lay within the two discriminators and start and end on the base line.
- PLT counted between 2 fl and 30 fl.  
 1 flexible Discriminator PL 2 to 6 fl.  
 1 flexible Discriminator PU 12-30 fl.  
 1 fixed Discriminator at 12 fl

$$MPV (fl) = \frac{Pct (\%)}{PLT (x 10^3/\mu l)}$$



### Parameters of the Thrombocyte histogram

- MPV (mean PLT volume) Ref range: 8 - 12 fl
- P-LCR (ratio of large platelets) Ref range: 15 - 35 %
- Increase could be a sign for:
  - PLT Clumps
  - Giant PLT
  - Microerythrocytes
- PDW, (platelet distribution width at 20 % of peak height) Ref range: 9 - 14 fl

Increase could be a sign for:

- PLT Clumps
- Microerythrocytes
- Fragments

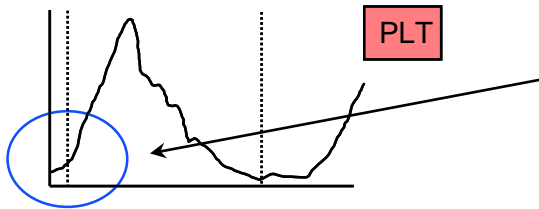


# K-Series: Histogram Interpretation

## Thrombocyte-Histogram

## Flagging

Mark “ PL “, abnormal height at lower discriminator



The curve does not start at the base line.

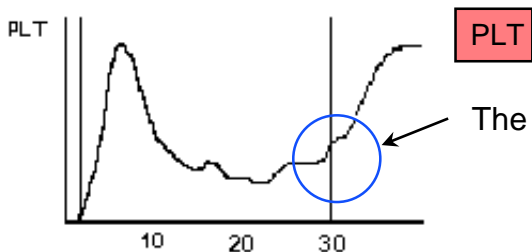
**Possible cause:**

- High blank value
- Cell fragments

**Caution :**

Check Blank! Auto Rinse

Mark “ PU “, abnormal height at upper discriminator



The curve does not end on the base line.

**Possible Cause :**

- PLT Clumps
  - EDTA-Incompatibility
  - Clotted sample
- Giant Platelets
- Microerythrocytes

**Caution :**

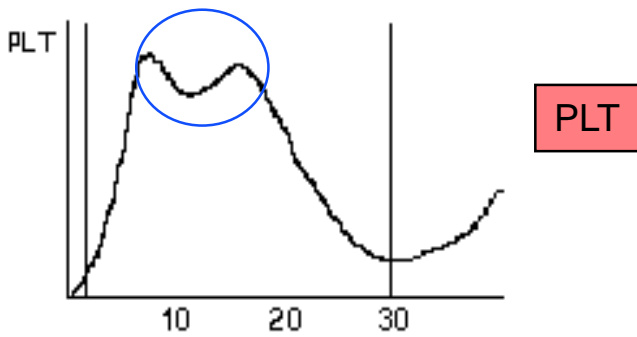
Check PLT-Result (and all parameters marked with “ PU “! In the event of perform the counting chamber or check PLT via Fonio!

# K-Series: Histogram Interpretation

## Thrombocyte-Histogram

## Flagging

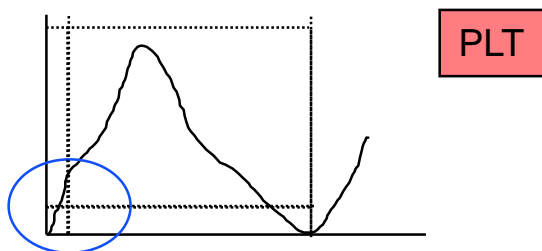
Mark "MP", Multi Peaks found



**Possible Cause:**

- Platelet transfusion

Mark "DW", Distribution With

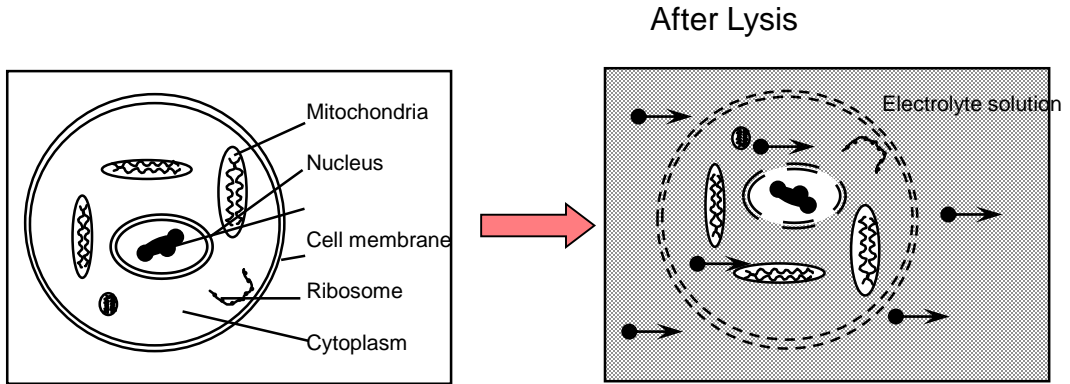


- The distribution can not be detected because the Histogram does not cross the 20 % limit twice.
- This curve is only an example but could also show another course.
- The overall height of the curve is always 100 %. The width is calculated on the 20 % height of the curve.

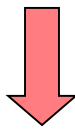
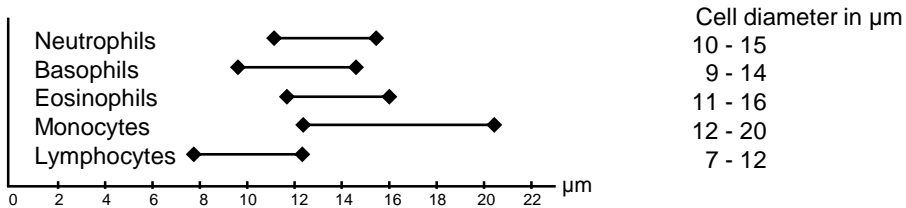
# K-Series: Histogram Interpretation

## Leukocyte-Histogram

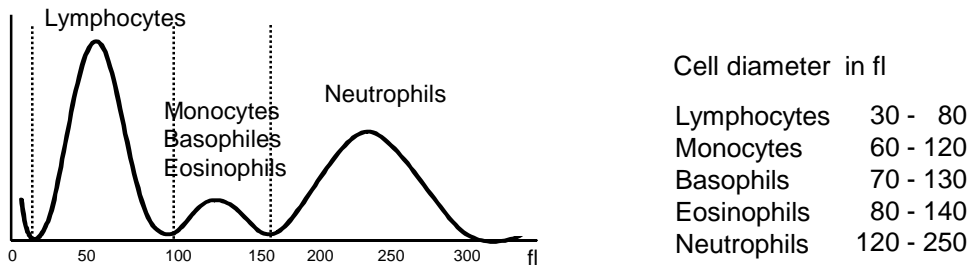
Lyse of RBC and partial lyse of WBC



Before adding lysing reagent

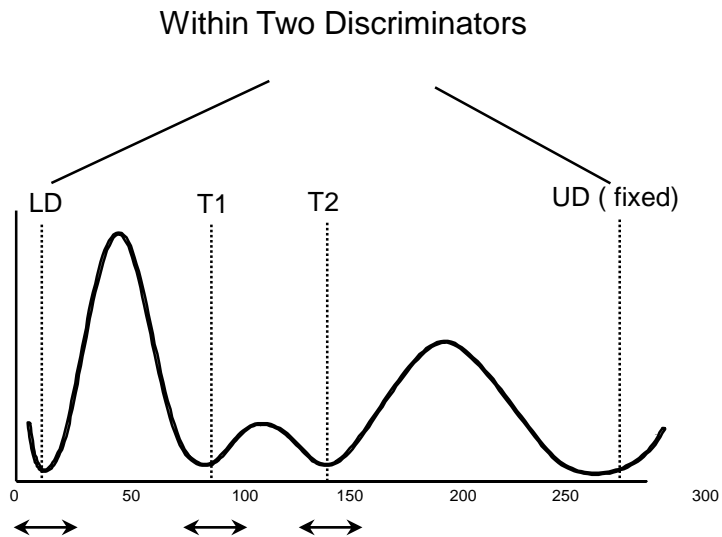


After adding lysing reagent



# K-Series: Histogram Interpretation

## Leukocyte-Histogram



### Important :

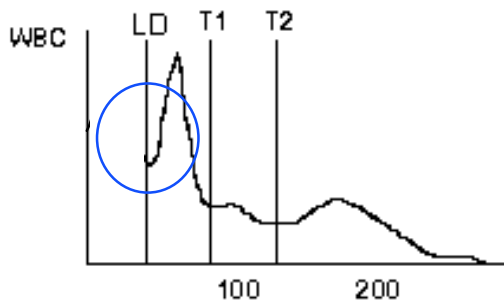
- The distribution curve should be within the discriminators. The curve should start and end at the basis line.
- The LD is flexible, but can not be lower than 30 fl.
- The WBC-channel shows Leukocytes and Thrombocytes ( Erythrocytes are lysed).
- The volume of the Thrombocytes is usually between 8 - 12 fl, therefore the LD at the WBC-Histogramm separates the Leukocytes from the Thrombocytes. (Thrombocytes were not counted).

# K-Series: Histogram Interpretation

## Leukocyte-Histogram

## Flagging

Flag “ WL “, Curve does not begin at the basis line

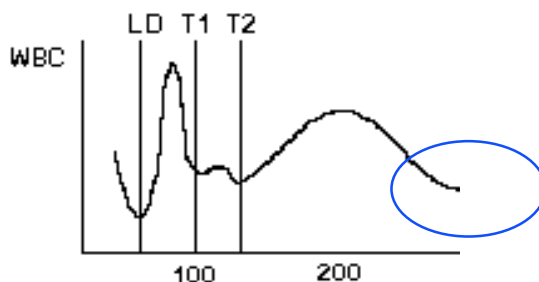


Possible causes :

- PLT Clumps  
EDTA-Incompatibility  
coagulated Sample
- high osmotic resistant (Erythrocytes not lysed)
- Erythroblasts
- cold agglutinate

**Caution :** Check WBC – Result and all parameters marked with “WL”

2. Flag “ WU “, Curve does not end at the base line.



**Caution:** Check WBC – Result and all parameters marked with “WL”  
Dilute sample 1:5 ? (high leukocyte count ? )

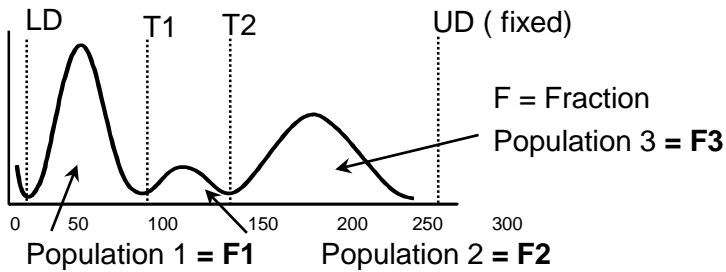
# K-Series: Histogram Interpretation

## Leukocyte-Histogram

## Flagging

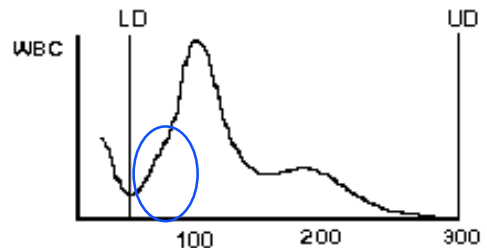
### 3. Flag "T1" and "T2"

T1 and T2 are valley discriminators defined by the plateau. This discriminators separates the Leukocytes populations.

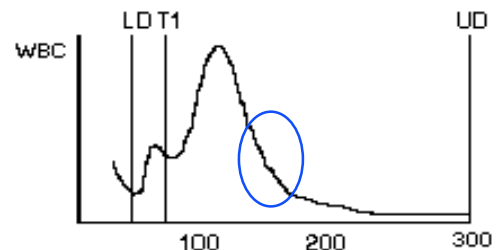


- The discriminators are flexible and will be set automatically according to the sample.
- In special cases is a separation from the valley discriminators not possible.

T1: T1 could not be detected  
No plateau was found.  
>T 1 flag



T2: T1 was detected but not T2  
>T2 flag



#### Attention:

- Confirm the result with the microscope if T1 or T 2 flag was indicated.
- The WBC result will be correct if no flag is indicated. All Leukocytes are counted.

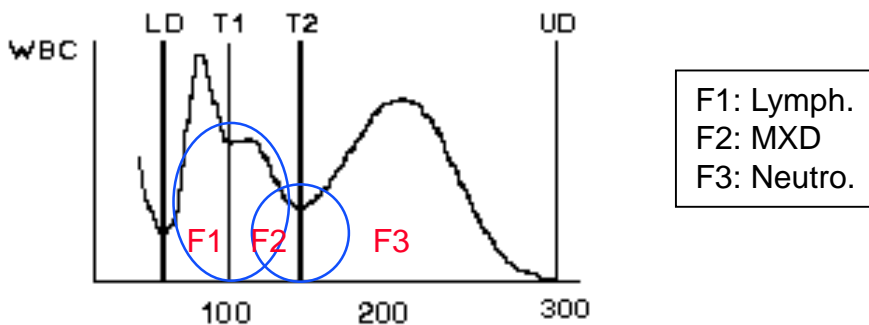
# K-Series: Histogram Interpretation

## Leukocyte-Histogram

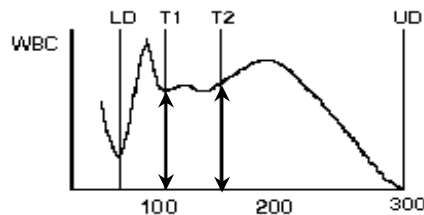
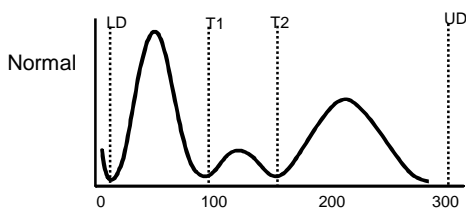
## Flagging

### 3. Flag “F1”, “F2” and “F3”

The Histogram of the Leukocytes is limited from the outer discriminators LD and UD.



- All Leukocytes are counted; WBC total is correct. (Assumption: no other flags)
- T 1 and T 2 were detected.
- Conspicuous is:  
The troughs are away from the basis line.



There is a potential of mixing populations.

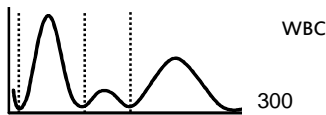
F 1 and F 2 move together, also F2 and F3.

To get a correct differential it is necessary to do a manual differentiation.

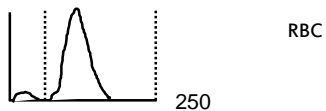
# K-Series: Histogram Interpretation

## Summary of all flags

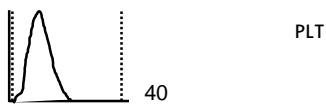
NO. 4  
 DATE: 9/10/95 15:11  
 MODE: WHOLE BLOOD  
 WBC 5,8 x10<sup>3</sup>/μl  
 RBC 4,84 x10<sup>6</sup>/μl  
 HGB 13,7 g/dl  
 HCT 42,0 %  
 MCV 86,8 fl  
 MCH 28,3 pg  
 MCHC 32,6 g/dl  
 PLT 257 x10<sup>3</sup>/μl



LYMPH% 31,2 %  
 MXD% 6,8 %  
 NEUT% 62,0 %  
 LYMPH# 1,8 x10<sup>3</sup>/μl  
 MXD# 0,4 x10<sup>3</sup>/μl  
 NEUT# 3,6 x10<sup>3</sup>/μl



RDW-SD 40,0 fl



PDW 13,1 fl  
 MPV 10,4 fl  
 P-LCR 28,1 %

**WL:** Abnormal height at lower discriminator of WBC Histogram (LD)  
**WU:** Abnormal height at upper discriminator of WBC Histogram (UD)  
**T1:** Valley 1 not found  
**T2:** Valley 2 not found  
**F1, F2, F3:** Abnormal height at the points **T1 or T2**; adjacent fractions are marked

**RL:** Abnormal height at lower discriminator of RBC Histogram (LD)  
**RU:** Abnormal height at upper discriminator of RBC Histogram (UD)  
**MP:** Multiple peaks: Distinguish ?? of two RBC Populations  
**DW:** The distribution (RDW) can not be detected because the Histogram does not cross the 20 % limit twice.  
**PL:** Abnormal height at lower discriminator of PLT Histogram (LD)  
**PU:** Abnormal height at upper discriminator of PLT Histogram (UD)  
**MP:** Multiple Peaks found  
**DW:** The distribution (PDW) can not be detected because the Histogram does not cross the 20 % limit twice.

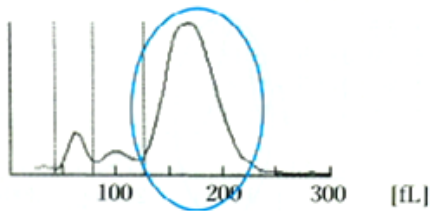
The following cases are analysed with the SYSMEX KX-21.  
 Differences of the Histogram-Version are instrument specific and have no analytical influence.



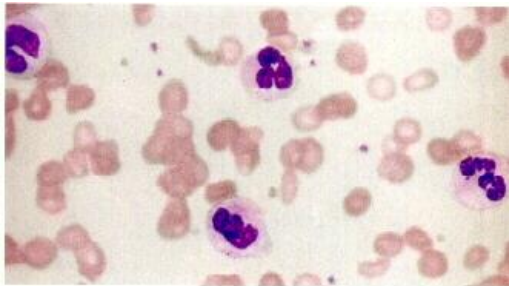
## Elevated number of WBC

### Neutrophilia

WBC-Histogram



Results		Differential	
WBC	+ 23.8 x 10 <sup>9</sup> /L	Band	8 %
LYM%	8.1%	Seg	77 %
MXD%	7.9%	Lymph	7 %
NEUT%	84.0%	Mono	7 %
		Eo	1 %
		Baso	0 %



(x 400)

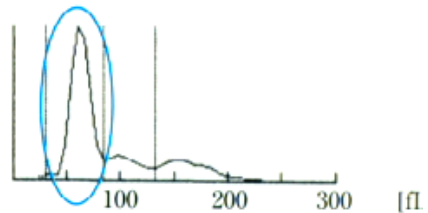
**Clinical diagnosis:** Neutrophilia

Prominent peak with broad distribution (NEUT%) for large leukocytes.

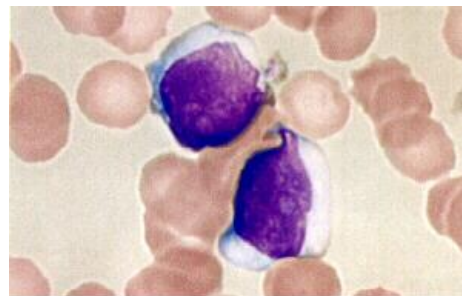
In case of Lymphocytopenia a similar curve is obtained.

### Lymphocytosis

WBC-Histogram



Results		Differential	
WBC	7.9 x 10 <sup>9</sup> /L	Band	4 %
LYM%	+ 64.7%	Seg	20 %
MXD%	15.8%	Lymph	64 %
NEUT%	- 19.5%	Mono	4 %
		Eo	5 %
		Baso	0 %
		Aty-Lym	3 %



(x 1000)

**Clinical diagnosis:** Lymphocytosis

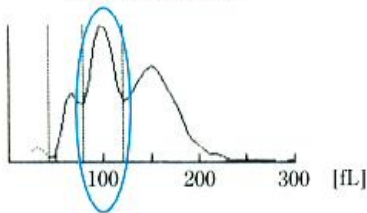
High, pointed peak in lympho area (LYM%).

In case of Neutropenia a similar curve is obtained.

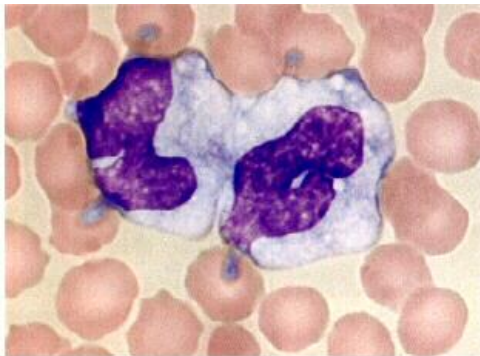
## Increase number of WBC

### Monocytosis

WBC-Histogram



Results		Differential	
WBC	7.7 x 10 <sup>9</sup> /L	Stab	8 %
LYM%F1 *	13.2%	Seg	37 %
MXD%F2 *	37.7%	Lymph	17 %
NEUT%	49.1%	Mono	35 %
		Eo	1 %
		Baso	0 %
		Met	1 %
		Aty-Lym	1 %



(x 1000)

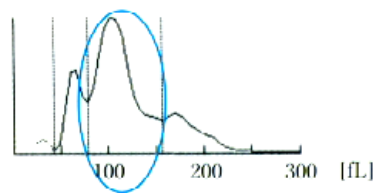
#### Clinical diagnosis: Monocytosis

Monocytes, which are the largest leukocytes in normal peripheral blood, become smaller than neutrophils under the influence of the lysing reagent. On the histogram, they fall in the middle cell ratio (MXD%) (○).

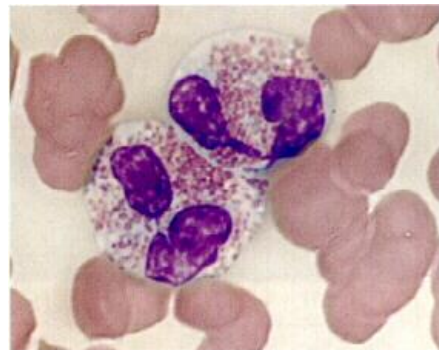
Similar patterns can be seen in eosinophilia. These two different clinical entities need to be differentiated from each other by manual differential.

### Eosinophilia

WBC-Histogram



Results		Differential	
WBC	4.3 x 10 <sup>9</sup> /L	Stab	1 %
LYM%	18,3%	Seg	19 %
MXD%	+ 62,2%	Lymph	20 %
NEUT%	- 19.5%	Mono	9 %
		Eo	47 %
		Baso	1 %
		My	1 %
		Met	1 %
		Aty-Lym	1 %



(x 1000)

#### Clinical diagnosis: Eosinophilia

Eosinophils and basophils, which are categorized as granulocytes together with neutrophils, are smaller than neutrophils due to contraction under the influence of the lysing reagent.

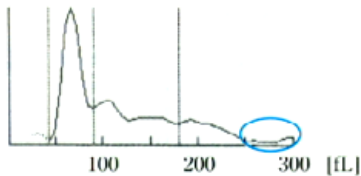
On the histogram, they are located in the middle cell ratio MXD% (○) where also monocytes are present.

A similar pattern can be seen in monocytosis. Both diseases must be differentiated from each other by manual differential.

## WBC Agglutination

Case 1

WBC-Histogram

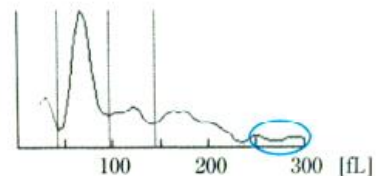


Results

WBC –  $2.3 \times 10^9/L$   
 LYM% 39.7%  
 MXD%+ 32.2%  
 NEUT% 28.1%

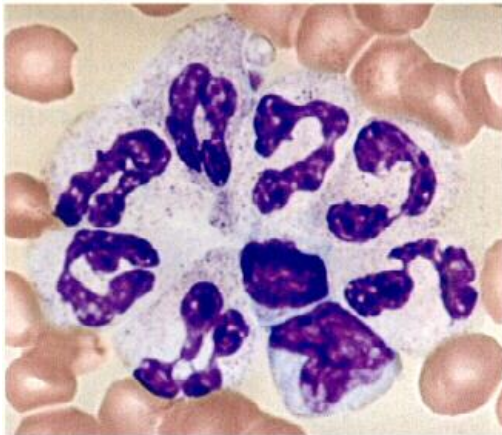
Case 2

WBC-Histogram

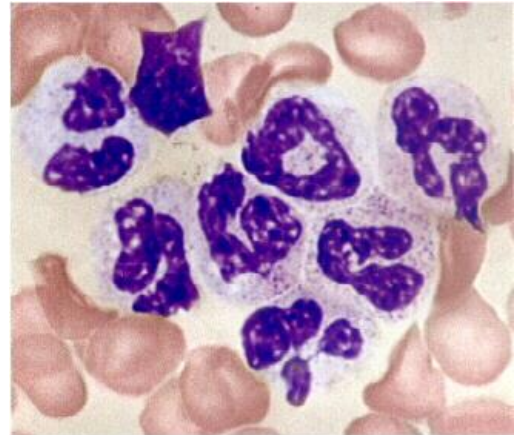


Results

WBC –  $2.1 \times 10^9/L$   
 LYM% 41.9%  
 MXD% 17.5%  
 NEUT%- 40.6%



(x 1000)

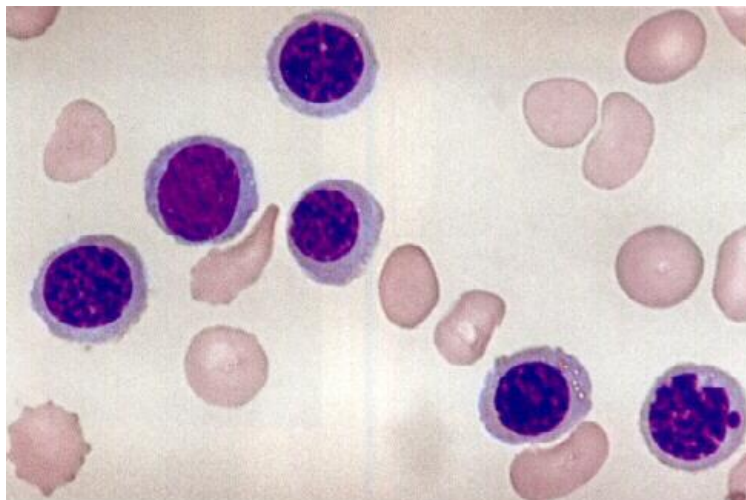
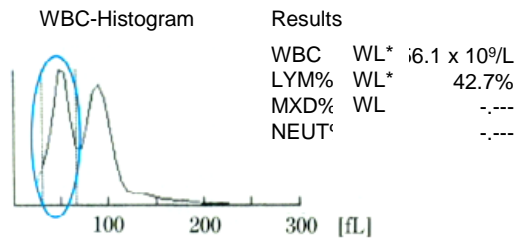


(x 1000)

Case: WBC-Agglutination


This is a case of WBC agglutination, which occurs rather rarely. The histogram does not show a clear tri-modal pattern, with particles present in the region above 250 fl (○). The count of leukocytes is likely to be falsely low. Depending on the nature of leucocytes antibodies, agglutination may be dissolvable and measurement may become possible upon incubation at 37 ° C or upon washing the samples with isotonic saline.

## Nucleated red blood cells (NRBC)



(x 1000)

**Case: Orthochromatic Erythroblasts (NRBC's)**  
at a concentration of 1352/100 WBC

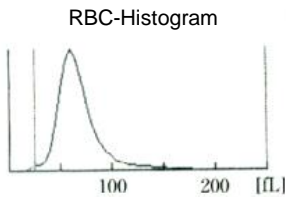
This is a sample with an extreme number of NRBC. The valley between the erythrocytes ghost area and the small leucocytes area exceeds the limit, and WL flags are given. NRBC are likely to contribute significantly to the population on the WBC histogram (  ); therefore most of them are counted as leukocytes. Measurement of samples having NRBC must be corrected by the following equation:

$$\text{corrected WBC Count} = \frac{\text{measured WBC-Count} \times 100}{(100 + \text{NRBC count}^*)}$$

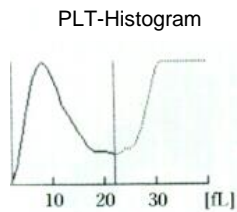
\* NRBC Count: The number of NRBC per 100 leukocytes.

## Anemia

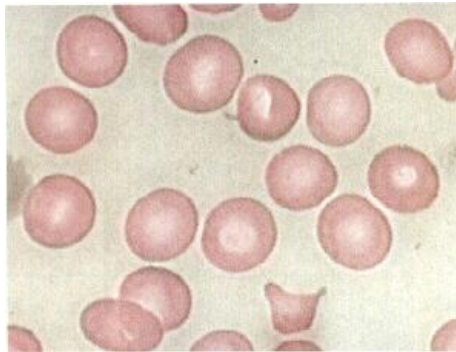
### Iron Deficiency Anaemia



Result	
RBC	.48 x10 <sup>12</sup> /L
HGB	8.8g/dl
HCT	29.3%
MCV	- 65.4fl
MCH	- 19.6pg
MCHC	- 30.0g/dl
RDW-C	+ 18.2%



Result	
PLT	PU*235 x10 <sup>9</sup> /L
PDW	11.7fl
MPV	9.4fl
P-LCR	21.7%



(x 1000)

#### 1. Case:

##### Results:

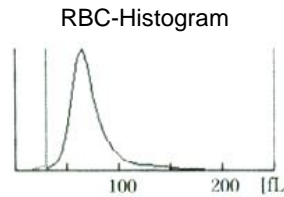
MCV, MCH and MCHC shows low values and RDW-SD shows a high value.

##### Differential:

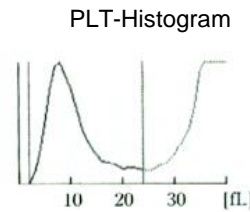
hypochromic RBC's

Thus this case is identified as microcytic hypochromic anemia

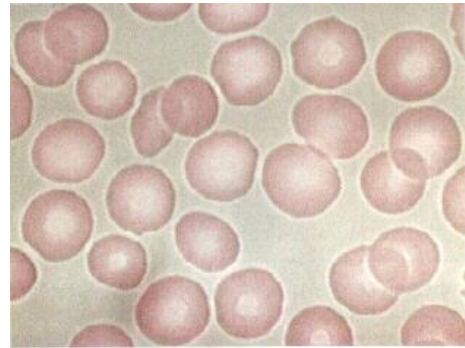
### Suspected Thalassemia



Result	
RBC	+ 37 x10 <sup>12</sup> /L
HGB	12.7g/dl
HCT	41.1%
MCV	- 68.8fl
MCH	- 21.3pg
MCHC	- 30.9g/dl
RDW	- 14.7%



Result	
PLT	391 x10 <sup>9</sup> /L
PDW	12.0fl
MPV	10.3fl
P-LCR	27.3%



(x 1000)

#### 2. Case:

##### Results:

MCV, MCH and MCHC shows low values

##### Differential:

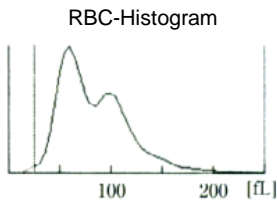
no prominence in the smear

Due to the increase in erythrocyte count and the low RDW value this case is classified as a thalassaemia minor.

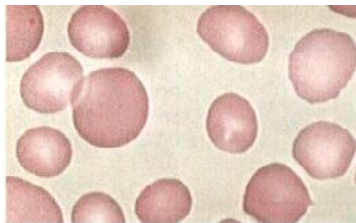
## Anemia

### Iron def. anaemia under treatment

2nd Week of treatment

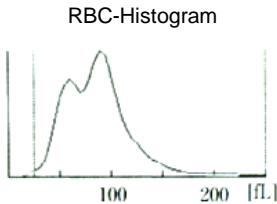


Results	
RBC	$17 \times 10^{12}/L$
HGt	10.4g/dl
HCT	35.3%
MCV	- 80.8fl
MCH	- 23.8pg
MCH	- 29.5g/dl
RDW	MP* + 35.7%

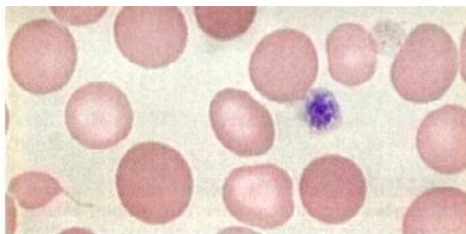


(x 1000)

4nd week of treatment



Results	
RBC	$4 \times 10^{12}/L$
HGB	13.2g/dl
HCT	42.5%
MCV	- 82.7fl
MCH	- 25.7pg
MCH	- 31.1g/dl
RDW	MP* + 31.9%

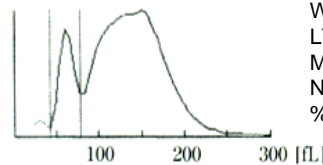


(x 1000)

The initial effect of the treatment can be seen in data of the 2th week, where the RBC histogram indicates the appearance of normocytic cells while a large number of microcytic cells still are visible in the smear. The RBC histogram of the 4th week still shows a 2-peak curve, but the peak of larger cells became more prominent than the other peak. Compared to the top diagram, this shows an further increase in the number of normocytes as a result of the treatment.

### Macrocytic Anaemia (CML)

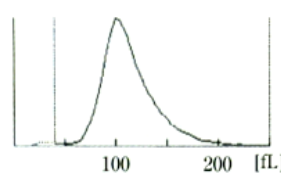
WBC-Histogram



Results

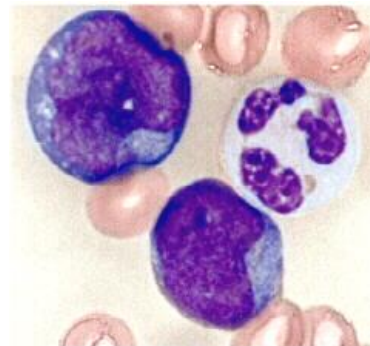
WBC	+ $17.3 \times 10^9/L$
LYM%	16.4%
MXD%	T <sub>2</sub> -
NEUT%	T <sub>2</sub> -
	%

RBC-Histogram

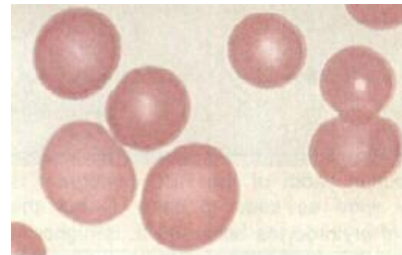


Results

RBC	- $.64 \times 10^{12}/L$
HGB	- 6.2g/dl
HCT	- 18.2%
MCV	+ 110.0fl
MCH	37.8pg
MCHC	34.1g/dl
RDW	15.2%



(x 1000)

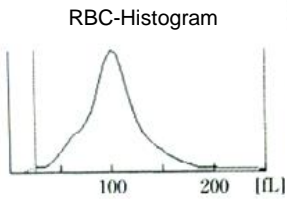


(x 1000)

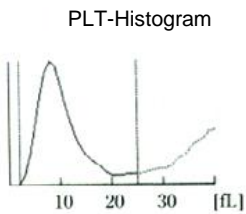
This is a macrocytic anaemia with development of chronic myelogenous leukemia (CML). The RBC histogram suggests the existence of macrocytes, while the WBC histogram does not show, the valley normally seen between the MXD and the large cell ratio, suggesting the appearance of leukocytes with various sizes.

## Anisocytosis

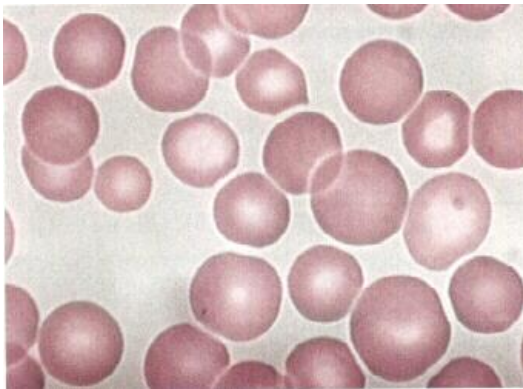
### Case1



Results	
RBC	$1.15 \times 10^{12}/L$
HGB	14.0g/dl
HCT	40.8%
MCV	98.3fl
MCH	33.7pg
MCHC	34.3g/dl
RDW	+ 22.7%



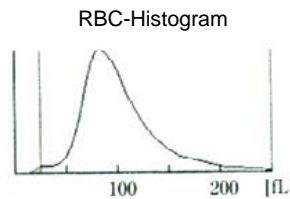
Results	
PLT	$328 \times 10^9/L$
PDW	12.4fl
MPV	10.2fl
P-LCR	26.5%



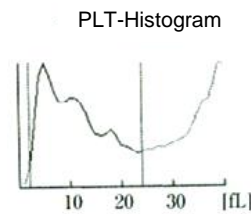
(x 1000)

Microcytes and macrocytes are visible among normocytes in the smear, and the distribution on the RBC histogram is abnormally wide. This suggest the appearance of various sizes of erythrocytes.

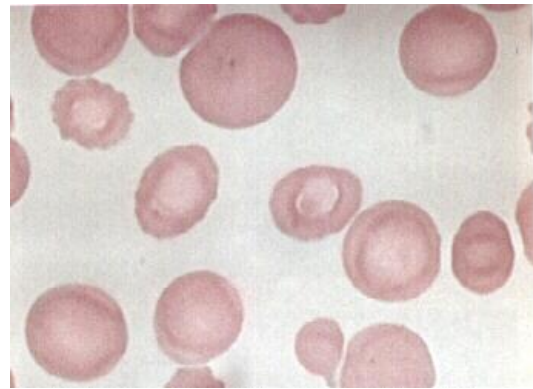
### Case2



Results	
RBC	$1.95 \times 10^{12}/L$
HGB	9.9g/dl
HCT	28.7%
MCV	97.3fl
MCH	33.6pg
MCHC	34.5g/dl
RDW	+ 26.4%



Results	
PLT	PL' $98 \times 10^9/L$
PDW	DW ---.fl
MPV	PL ---.fl
P-LCR	PL ---.-%

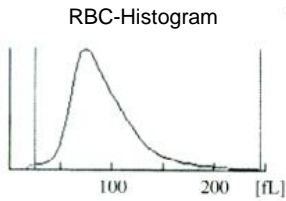


(x 1000)

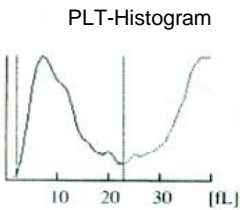
The distribution width of the RBC histogram is abnormally wide as seen in case 1, but the proportion of erythrocytes below 90 fl is higher in case 2. The PLT histogram indicates abnormality and the PL and DW flags are given. This suggest that microcytes may have interferred with the Platelet count. Such result needs to be confirmed by other methods, like Fonio method or counting chamber.

## Poikilocytosis

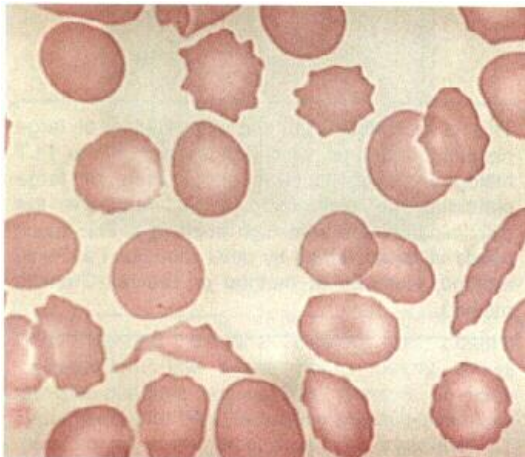
### Case 1



Results	
RBC	1.62 x10 <sup>12</sup> /L
HGB	11.1g/dl
HCT	31.9%
MCV	88.1fl
MCH	30.7pg
MCHC	34.8g/dl
RDW	+ 25.5%

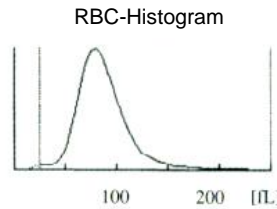


Results	
PLT	152 x10 <sup>9</sup> /L
PDW	16.2fl
MPV	10.4fl
P-LCR	31.4%

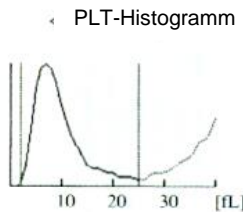


(x 1000)

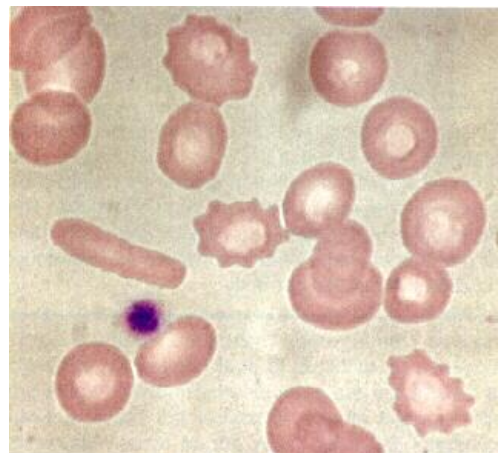
### Case 2



Results	
RBC	1.67 x10 <sup>12</sup> /L
HGB	- 6.2g/dl
HCT	- 22.5%
MCV	- 84.3fl
MCH	- 23.2pg
MCHC	- 27.6g/dl
RDW	+ 20.1%



Results	
PLT	235 x10 <sup>9</sup> /L
PDW	11.7fl
MPV	9.4fl
P-LCR	21.7%



(x 1000)

Two cases: Poikilocytosis with a lot of echinocytes

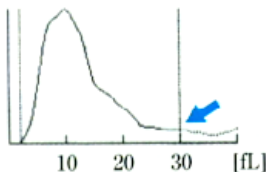
The abnormally wide distribution on the RBC histogram suggests the appearance of various sizes of erythrocytes with a high percentage of microcytes.



## Large Platelets

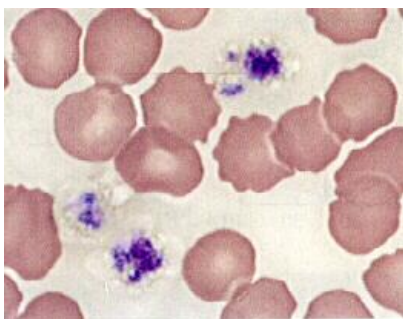
### Case 1

PLT-Histogram



Results

PLT		237 x10 <sup>9</sup> /L
PDW	+	18.0fl
MPV		12.4fl
P-LCR	+	44.1%



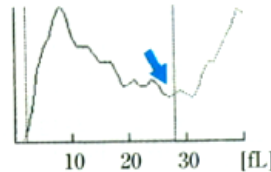
(x 1000)

#### Case 1: Giant platelets

The abnormally wide distribution on the PLT histogram suggests the appearance of giant platelets. The distribution curve intersects the discriminator line at a low point, which shows that the platelet count has been measured correctly.

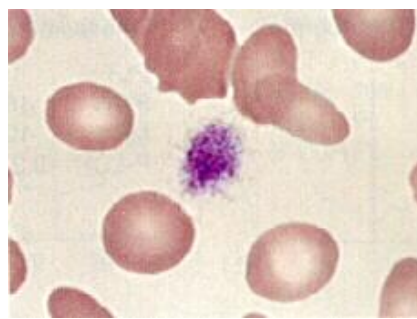
### Case 2

PLT-Histogram



Results

PLT	PU	71 x10 <sup>9</sup> /L
PDW	DW	---.fl
MPV	DW	---.fl
P-LCR	DW	---.-%



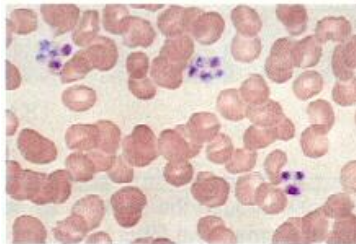
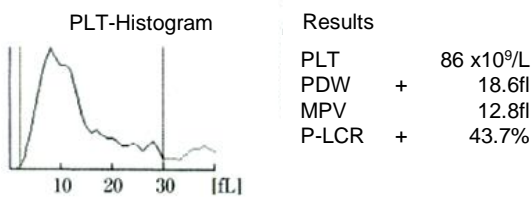
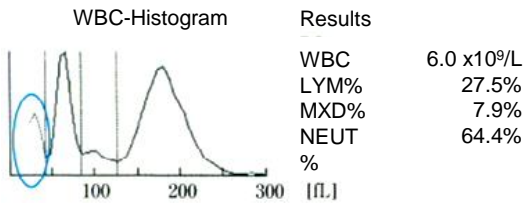
(x 1000)

#### Case 2: large platelets

Although the wide distribution on the PLT histogram suggests the appearance of large platelets, the distribution curve intersects the discrimination line at a high point. This result needs to be confirmed by other methods i.e Fonio method or counting chamber.

## Platelet Aggregation

### Case 1

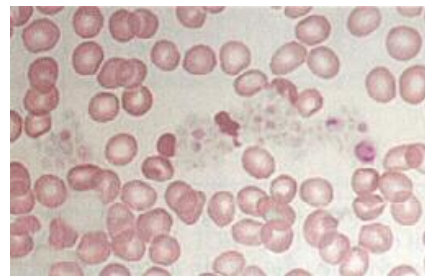
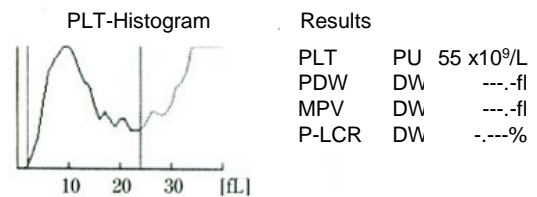
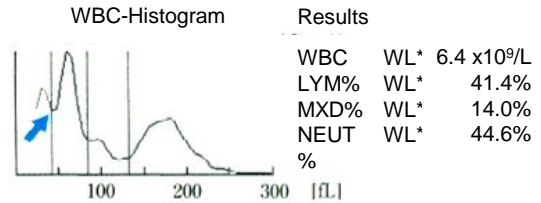


(x 400)

#### Case 1: Platelet Aggregation

The smear clearly shows that platelets are aggregating. The WBC histogram shows a peak in the ghost area ( ), while the PLT histogram shows a wide distribution. Although these large particles usually affect the leucocyte counts, the leukocytes distribution of case 1 is well separated from the ghost area on the WBC histogram, probably without any effect of small particles in the ghost area. There is no WL Alarm given .

### Case 2



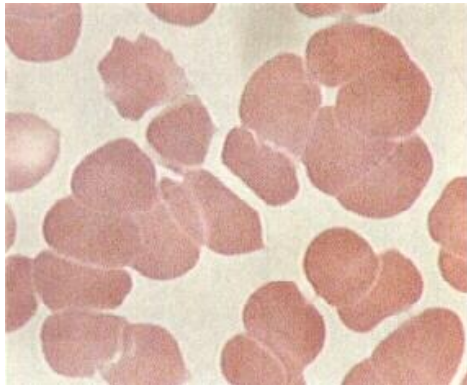
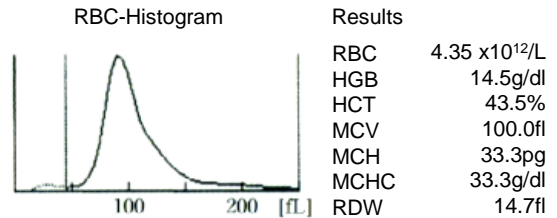
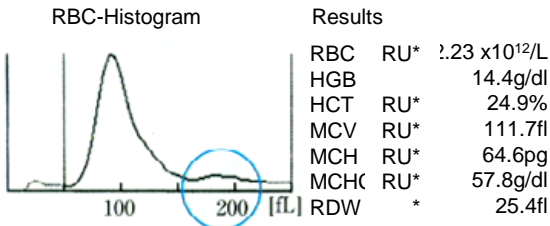
(x 400)

#### Case 2: Platelet Aggregation

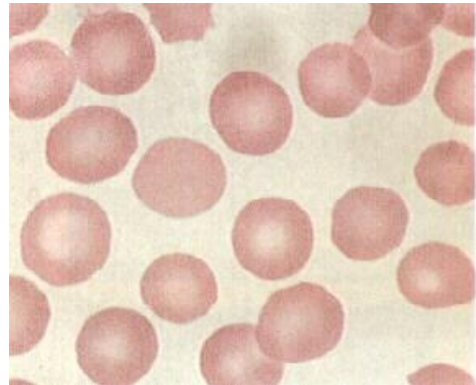
This sample contains larger aggregation clusters as shown in the smear. These clusters are considered affect the leucocyte counts, because the distribution curve on the WBC histogram intersects the discriminator line between the ghost and the Small cell ratio at a high point, and the WL flags are given. The PLT histogram suggests the presence of large particles. Analysis of a fresh blood sample is required to obtain correct platelet values.

## Cold Agglutinins

Incubation 30 min



(x 1000)



(x 1000)

### Case: Cold agglutinins

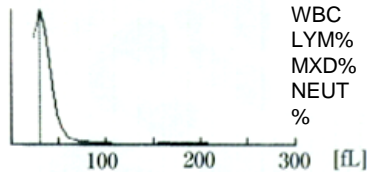
Because in this case erythrocytes have passed through the detector as clusters of several cells, the RBC, HCT, MCH, MCV, MCHC and RDW values are abnormal. The RBC histogram shows a second peak.

After the clusters have been dissolved by incubation, all erythrocytes are detected as single cells. Therefore the second peak on the RBC histogram does not appear and the RBC, HCT, MCV, MCH, MCHC and RDW values are normal.

# K-Series: Histogram Interpretation

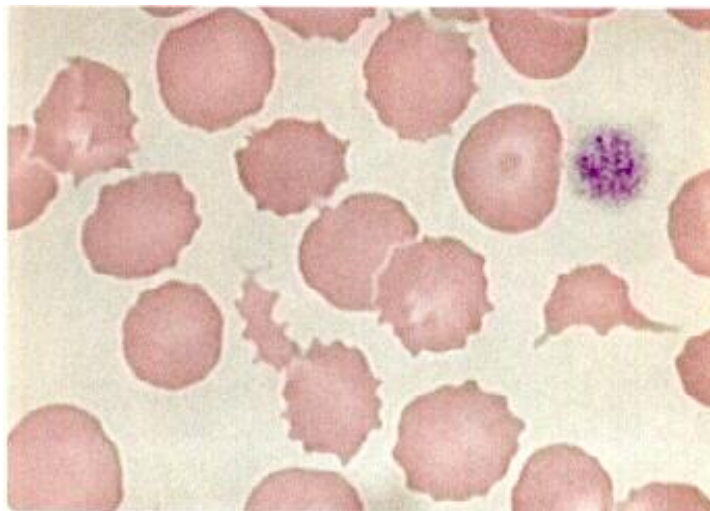
## Insufficient Lysing of Erythrocytes

WBC-Histogram



Results

WBC	WL*	49.4 x10 <sup>9</sup> /L
LYM%	WL	----
MXD%	WL	----
NEUT	WL	----
%		



(x 1000)

### Case: Lyse Resistance RBC

The histogram show a pattern typically seen in insufficient lysing of erythrocytes. On the WBC histogram the distribution curve intersects the WBC lower discrimination line at an abnormally high point. The WL flag is output and asterisk marks are put to the leucocyte value, warning of low reliability of the data.

This is frequently seen with blood samples taken from hepatic disease patients or very early newborns. These problems are solved by diluting the sample or replacing plasma with cellpack (blood cell washing).

The smear photo shows large platelets and acanthocytes, suggesting hepatic diseases.