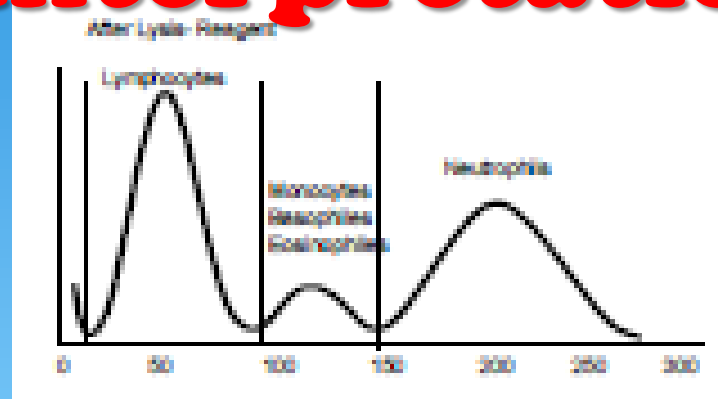


Histograms Interpretation



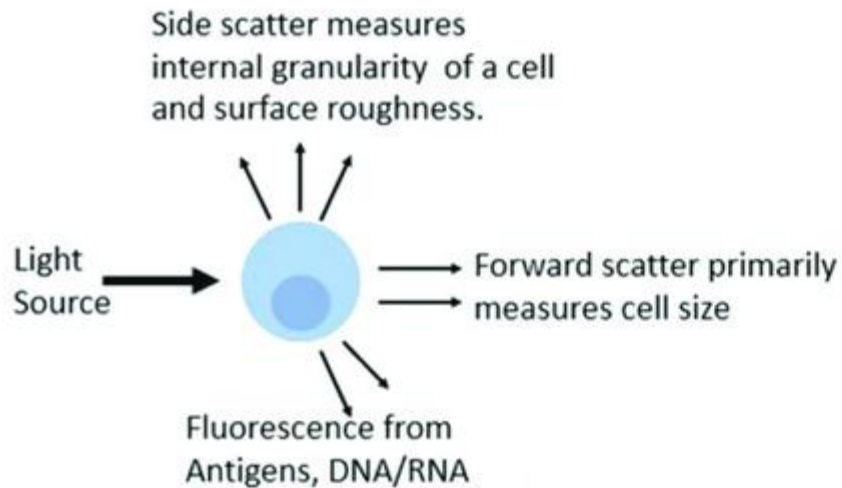
Mt Hojjati

(PhD in Hematology and transfusion medicine

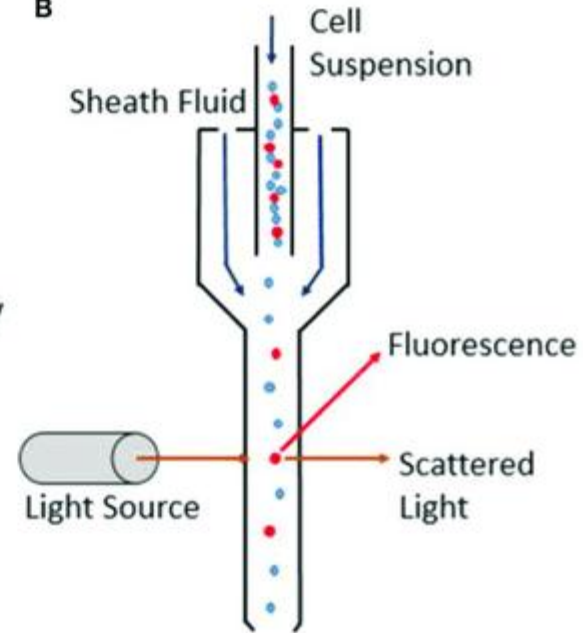
Golestan University of medical sciences

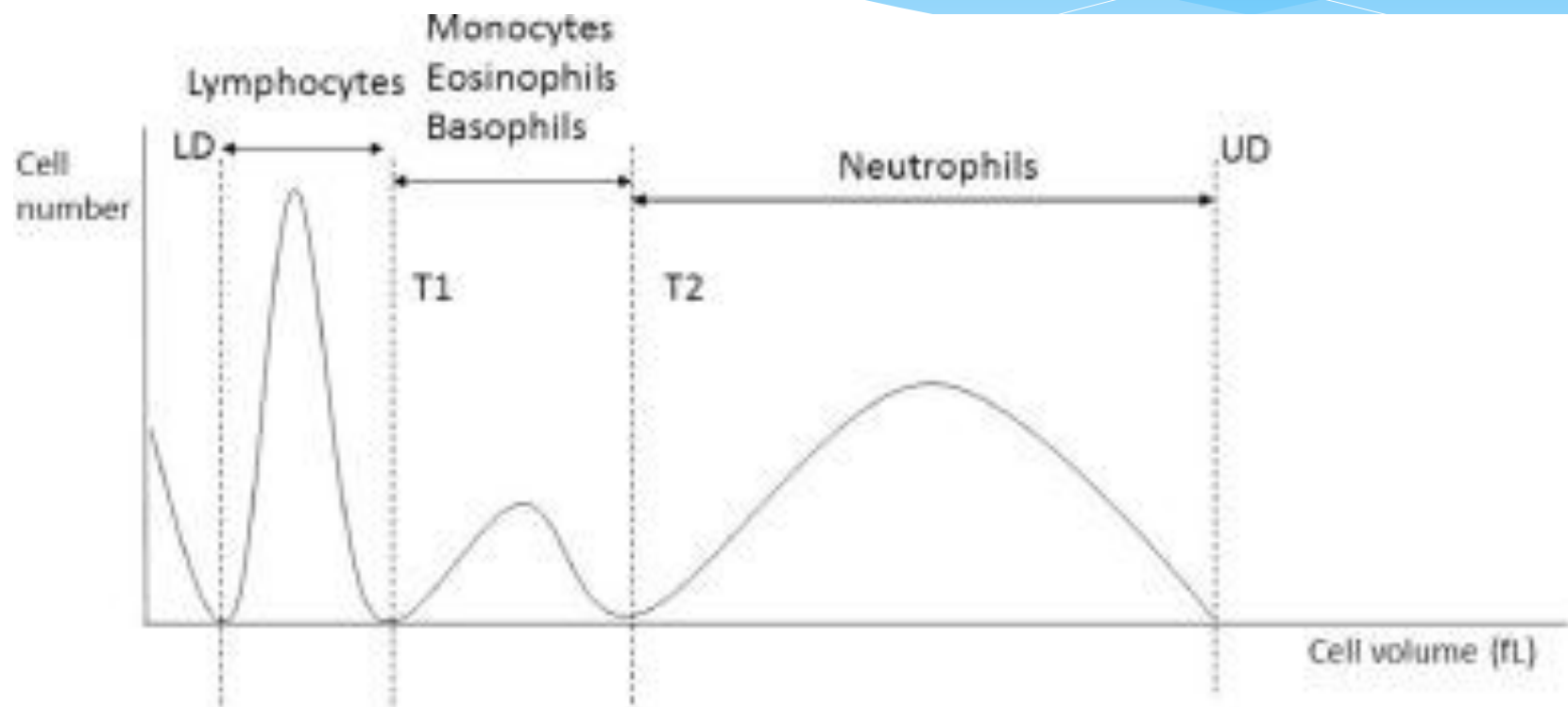
Histogram

A

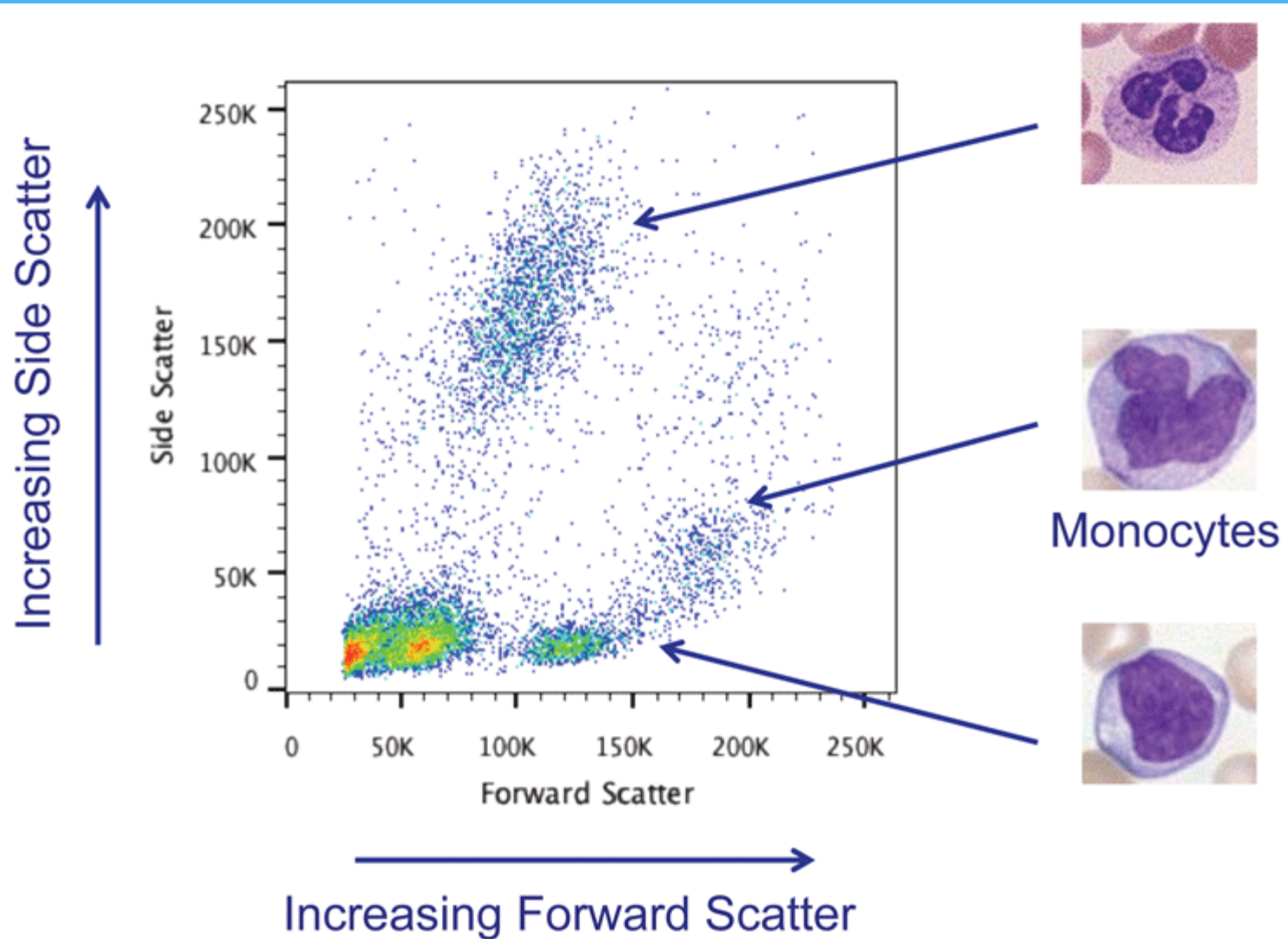


B

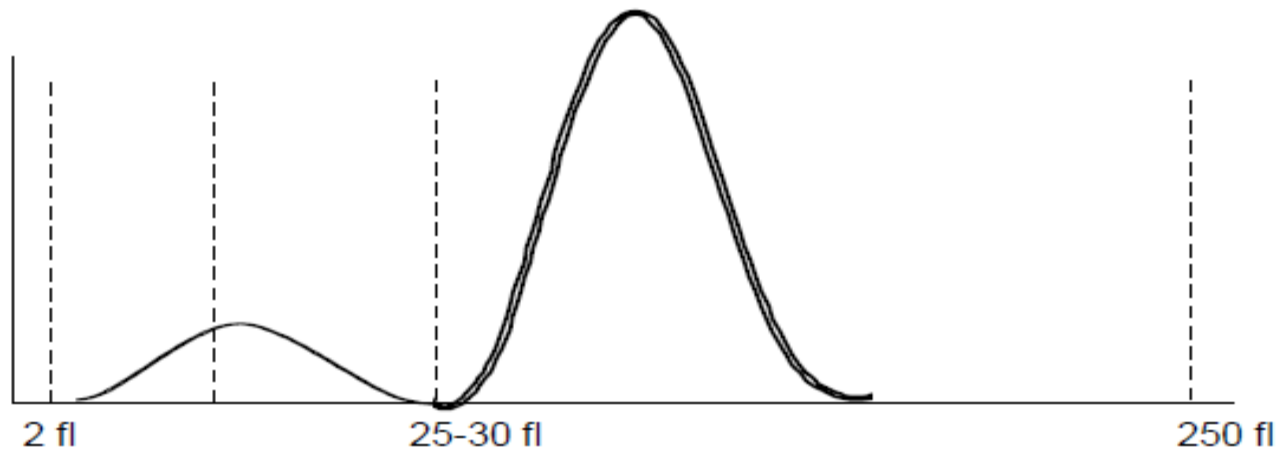




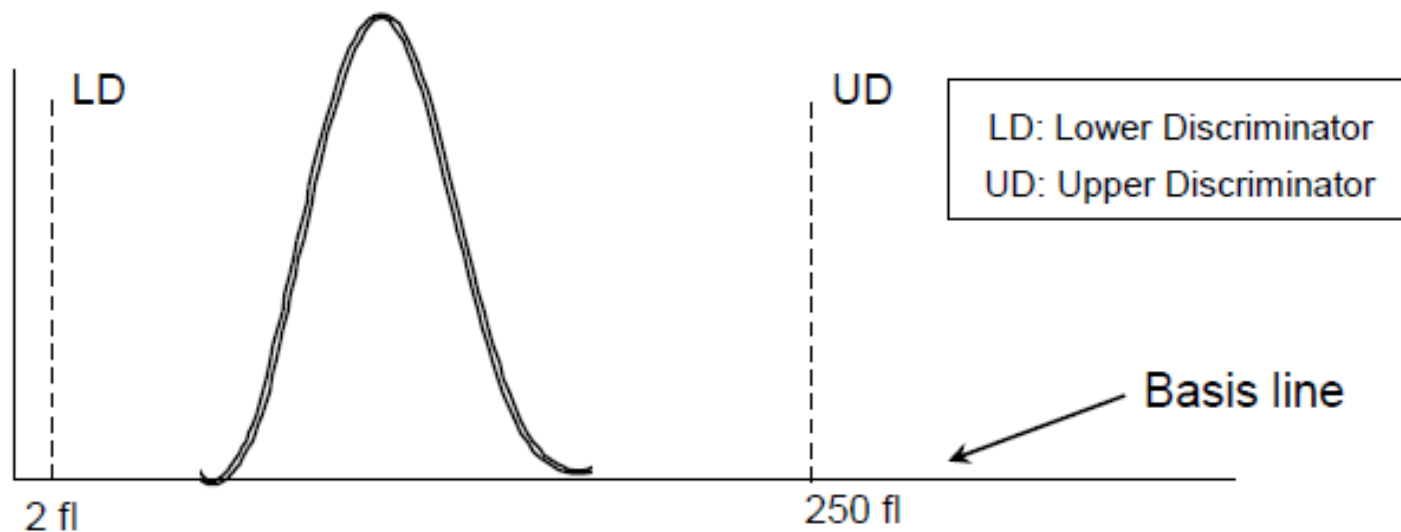
5 part diff



RBC- and PLT-Histograms



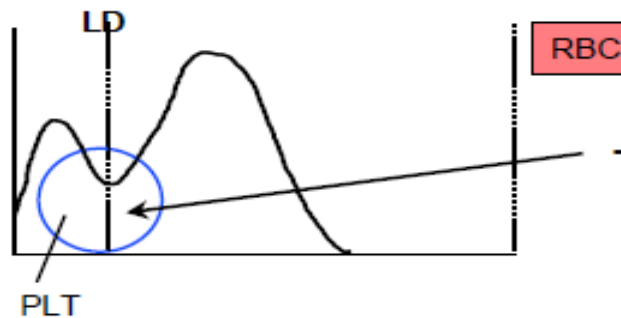
- The two distribution curves are separated from each other by a moving auto discriminator looking to the Plateau.
- Platelets have a size between 8 and 12 fl and are counted between 2 and 30 fl.
- Erythrocytes have a size of 80-100 fl and are counted between 25 and 250 fl.



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

Erythrocyte-Histogram Flagging

Mark "RL", abnormal height at lower discriminator



The curve does not start at the base line.

Possible causes:

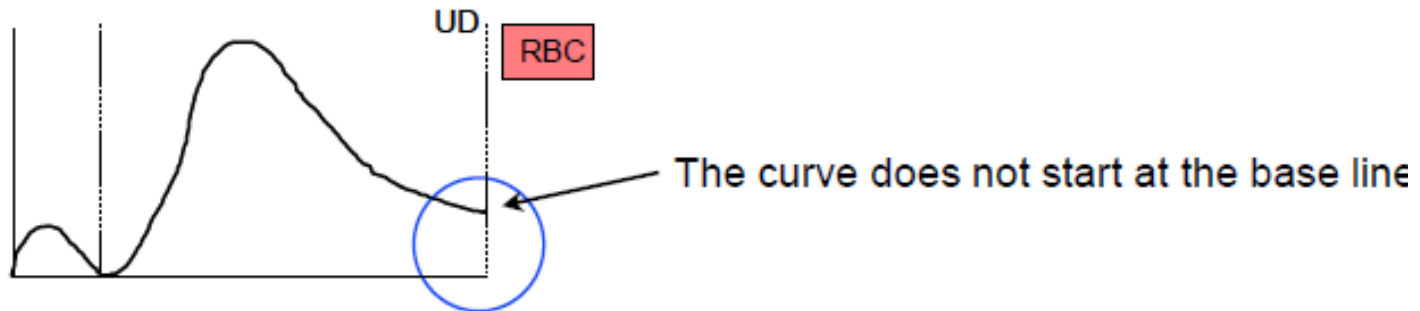
- Giant Platelets
- Micro-Erythrocytes
- Platelet Clumps

Caution:

All results marked with "RL" should be controlled.

Erythrocyte-Histogram Flagging

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



Possible causes:

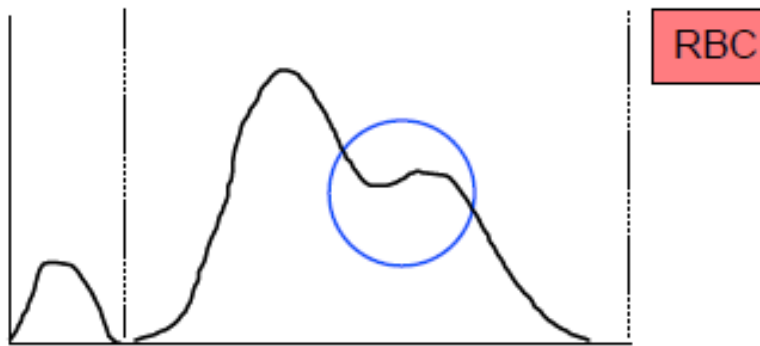
- Cold Agglutinins (check MCHC > 40 g/dl)
- Erythroblasts / Normoblasts

Caution :

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

Erythrocyte-Histogram Flagging

“MP”, multiple peaks found

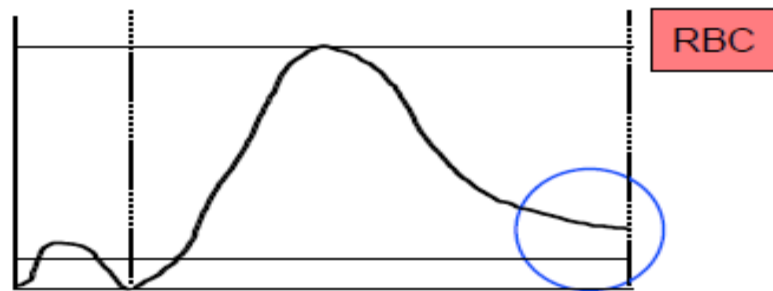


Possible causes:

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

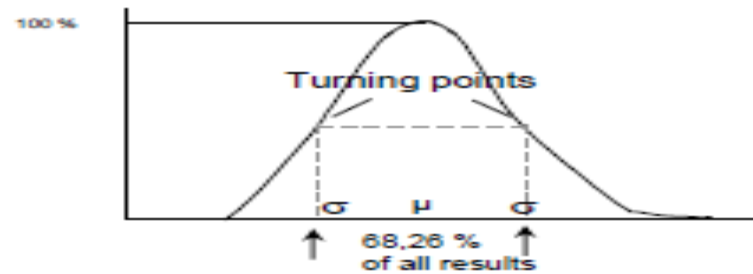
Erythrocyte-Histogram Flagging

“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.

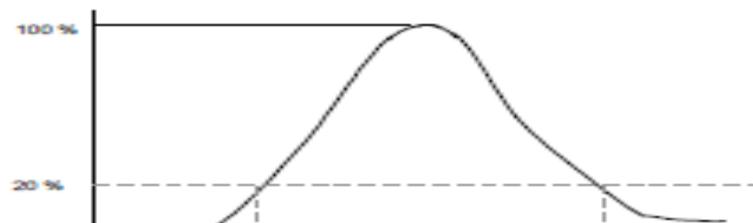
RDW-CV



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

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

RDW-SD

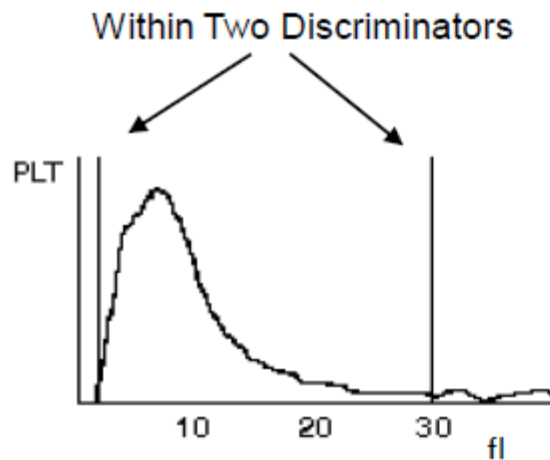


$$\text{RDW-SD} = 37 - 46 \text{ fl}$$

Clinical relevant $> 60 \text{ fl}$

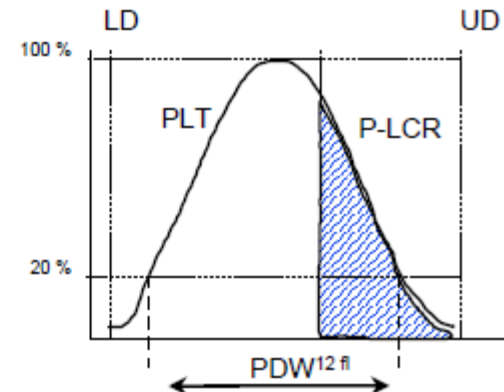
RBC Distribution Curve as a parameter for anisocytosis

Thrombocyte-Histogram



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

- 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



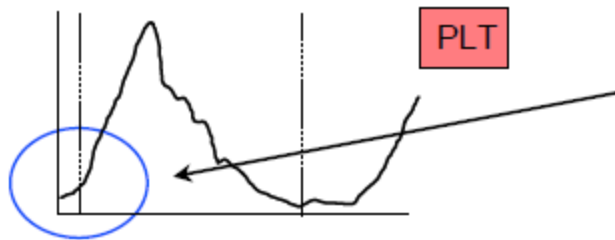
Parameters of the Thrombocyte histogram

- 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

Thrombocyte-Histogram Flagging

Mark " PL ", abnormal height at lower discriminator



The curve does not start at the base line

Possible cause:

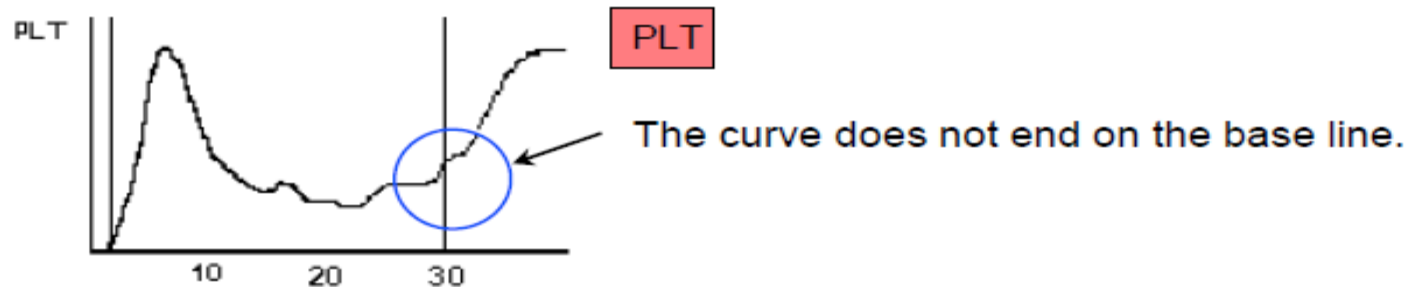
- High blank value
- Cell fragments

Caution :

Check Blank! Auto Rinse

Thrombocyte-Histogram Flagging

Mark “ PU “, abnormal height at upper discriminator



Possible Cause :

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

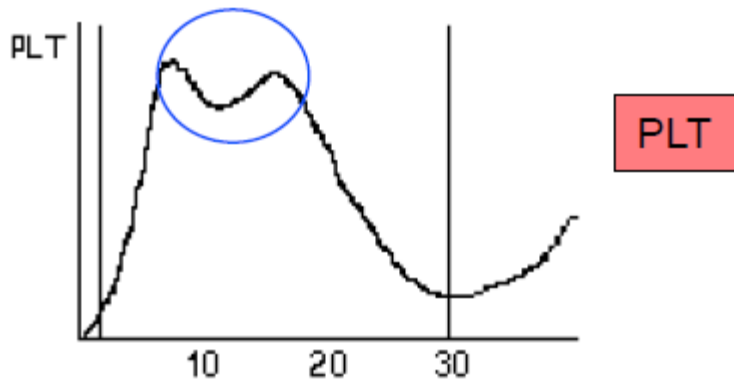
Caution :

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

Thrombocyte-Histogram Flagging

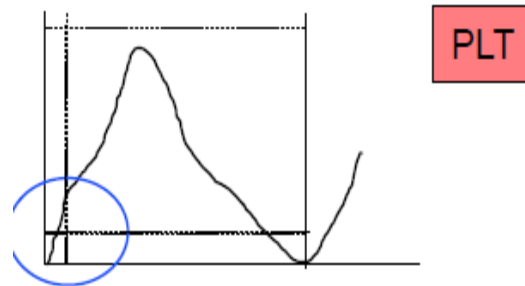
Mark "DW", Distribution With

Mark "MP", Multi Peaks found



Possible Cause:

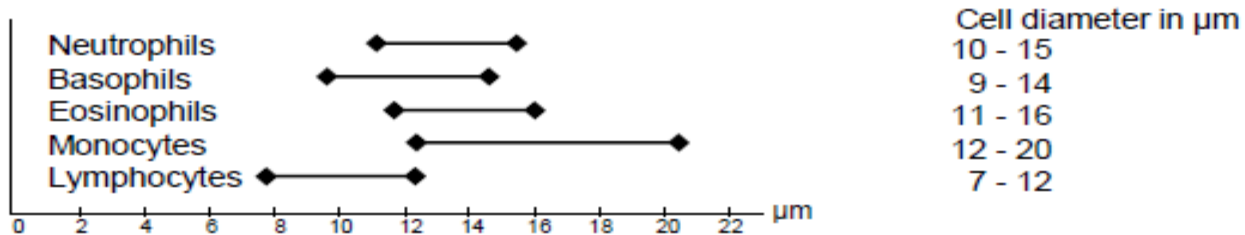
- Platelet transfusion



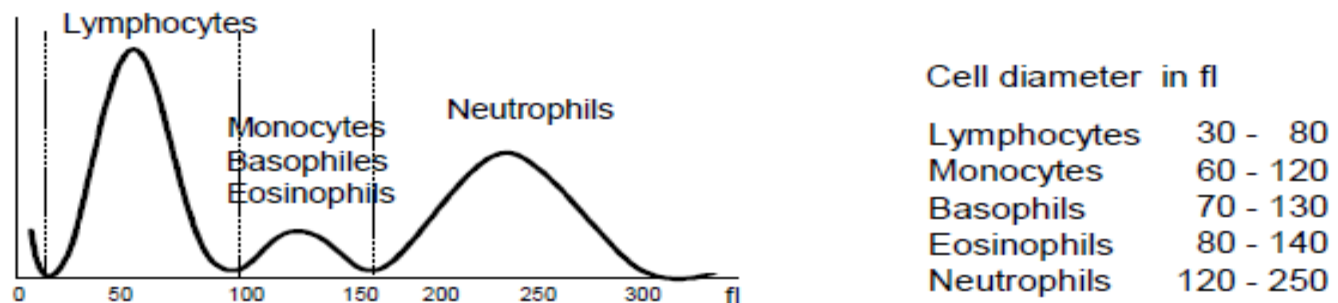
- The distribution can not be detected because the Histogram does not cross the 20 % limit twice.
- This curve is only an example but could also show another course.
- The overall height of the curve is always 100 %. The width is calculated on the 20 % height of the curve.

Leukocyte-Histogram

Before adding lysing reagent

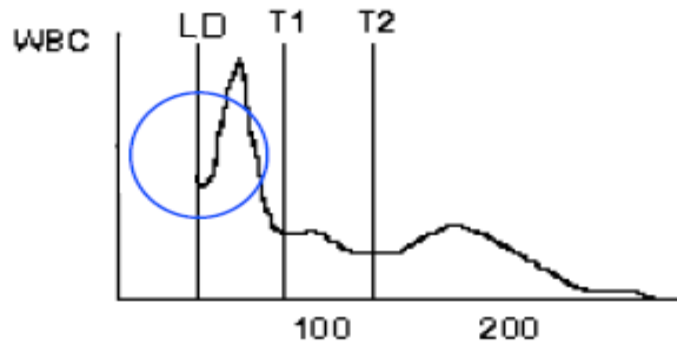


After adding lysing reagent



Leukocyte-Histogram Flagging

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



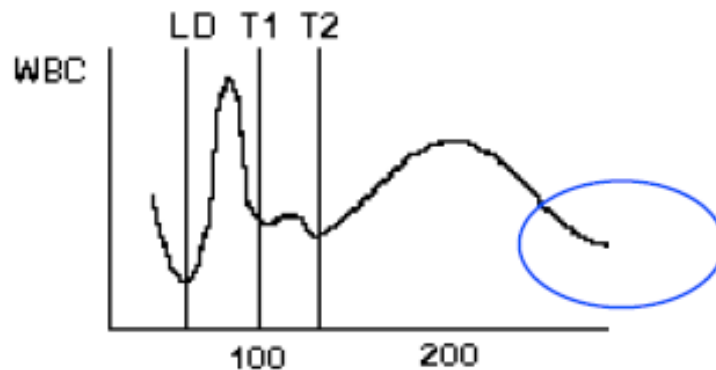
Possible causes :

- 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”

Leukocyte-Histogram Flagging

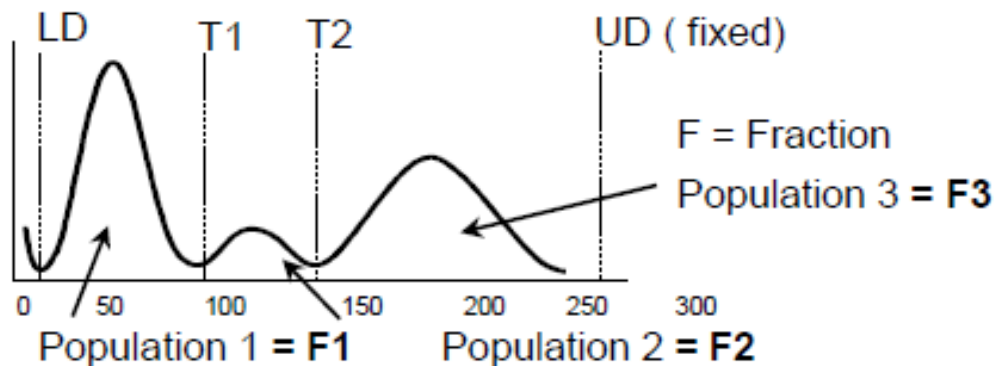
2. Flag "WU", Curve does not end at the base line.



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

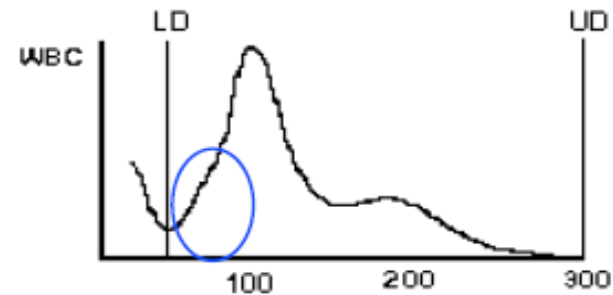
3. Flag "T1" and "T2"

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

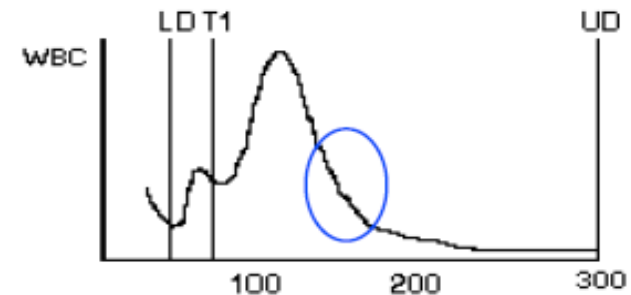


- The discriminators are flexible and will be set automatically according to the sample.
- In special cases is a separation from the valley discriminators not possible.

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



T2: T1 was detected but not T2
>T2 flag



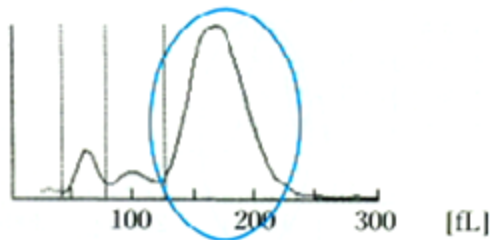
Attention:

- 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.

Elevated number of WBC

Neutrophilia

WBC-Histogram



Results

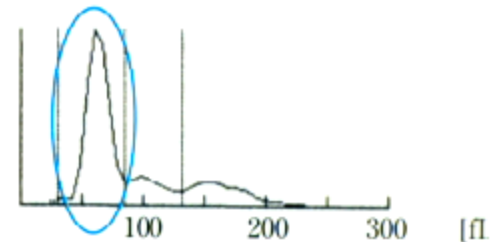
WBC + $23.8 \times 10^9/L$
 LYM% 8.1%
 MXD% 7.9%
 NEUT% 84.0%

Differential

Band 8 %
 Seg 77 %
 Lymph 7 %
 Mono 7 %
 Eo 1 %
 Baso 0 %

Lymphocytosis

WBC-Histogram



Results

WBC $7.9 \times 10^9/L$
 LYM% + 64.7%
 MXD% 15.8%
 NEUT% - 19.5%

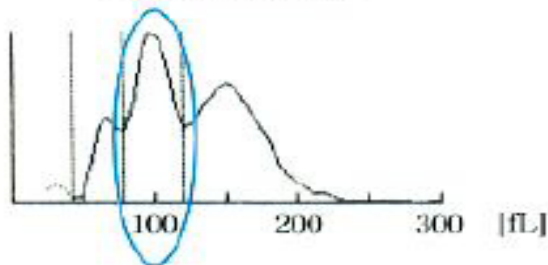
Differential

Band 4 %
 Seg 20 %
 Lymph 64 %
 Mono 4 %
 Eo 5 %
 Baso 0 %
 Aty-Lym 3 %

Increase number of WBC

Monocytosis

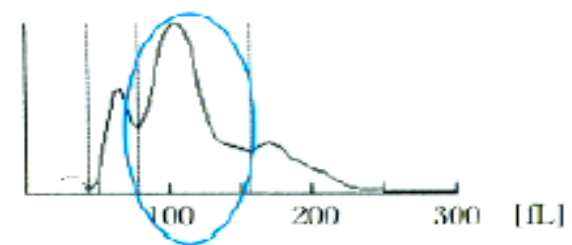
WBC-Histogram



| Results | | Differential | |
|----------|--------------------------|--------------|------|
| WBC | 7.7 x 10 ⁹ /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 % |

Eosinophilia

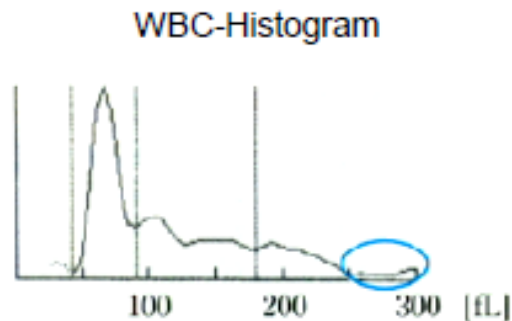
WBC-Histogram



| Results | | Differential | |
|---------|--------------------------|--------------|------|
| WBC | 4.3 x 10 ⁹ /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 % |

WBC Agglutination

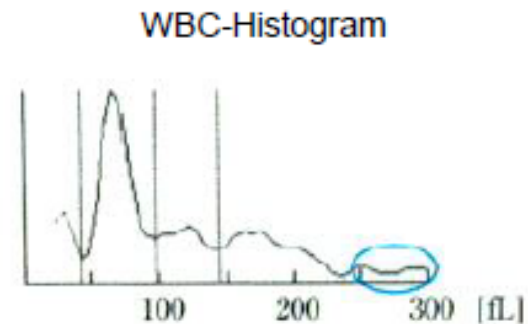
Case 1



Results

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

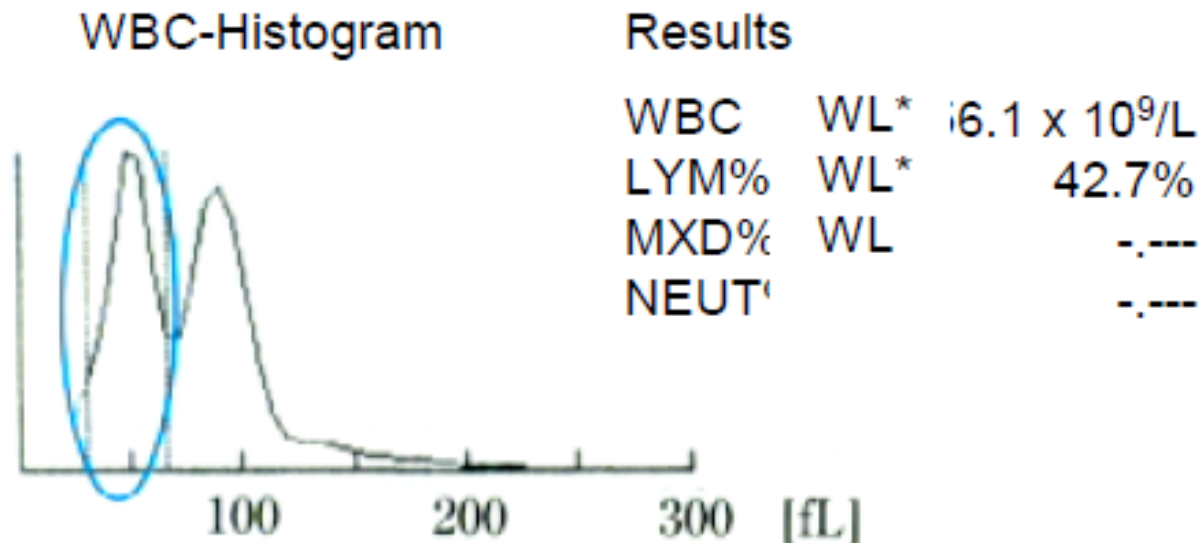
Case 2



Results

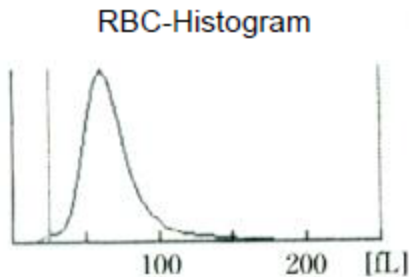
WBC - $2.1 \times 10^9/L$
LYM% 41.9%
MXD% 17.5%
NEUT% - 40.6%

Nucleated red blood cells (NRBC)



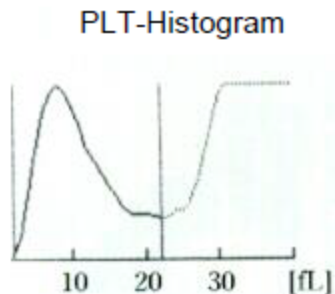
Anemia

Iron Deficiency Anaemia



Result

| | | |
|-------|---|---------------------------|
| RBC | | 4.48 x10 ¹² /L |
| HGB | | 8.8g/dl |
| HCT | | 29.3% |
| MCV | - | 65.4fl |
| MCH | - | 19.6pg |
| MCHC | - | 30.0g/dl |
| RDW-C | + | 18.2% |

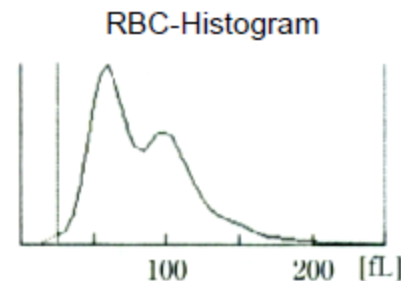


Result

| | | |
|-------|--|-------------------------|
| PLT | | 235 x10 ⁹ /L |
| PDW | | 11.7fl |
| MPV | | 9.4fl |
| P-LCR | | 21.7% |

Iron def. anaemia under treatment

2nd Week of treatment

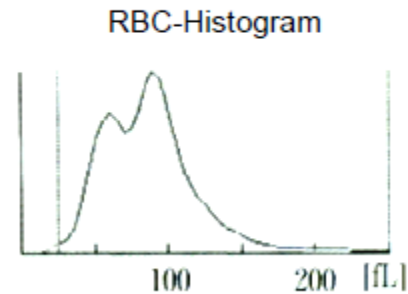


Results

| | | |
|------|-------|---------------------------|
| RBC | | 7.17 x10 ¹² /L |
| HGB | | 10.4g/dl |
| HCT | | 35.3% |
| MCV | - | 80.8fl |
| MCH | - | 23.8pg |
| MCHC | - | 29.5g/dl |
| RDW | MP* + | 35.7% |

(x 1000)

4nd week of treatment



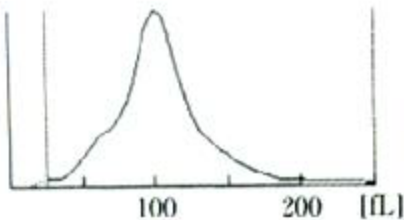
Results

| | | |
|------|-------|--------------------------|
| RBC | | 4.1 x10 ¹² /L |
| HGB | | 13.2g/dl |
| HCT | | 42.5% |
| MCV | - | 82.7fl |
| MCH | - | 25.7pg |
| MCHC | - | 31.1g/dl |
| RDW | MP* + | 31.9% |

Anisocytosis and Poikilocytosis

Case1

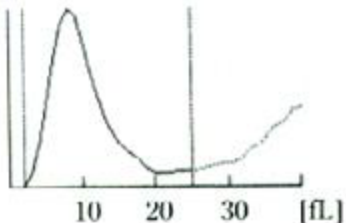
RBC-Histogram



Results

| | |
|------|------------------------|
| RBC | $.15 \times 10^{12}/L$ |
| HGB | 14.0g/dl |
| HCT | 40.8% |
| MCV | 98.3fl |
| MCH | 33.7pg |
| MCHC | 34.3g/dl |
| RDW | + 22.7% |

PLT-Histogram

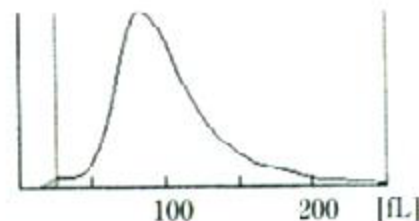


Results

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

Case2

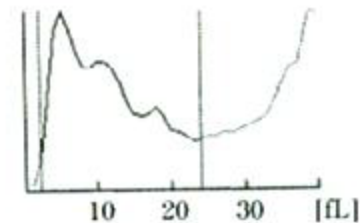
RBC-Histogram



Results

| | |
|------|------------------------|
| RBC | $.95 \times 10^{12}/L$ |
| HGB | 9.9g/dl |
| HCT | 28.7% |
| MCV | 97.3fl |
| MCH | 33.6pg |
| MCHC | 34.5g/dl |
| RDW | + 26.4% |

PLT-Histogram

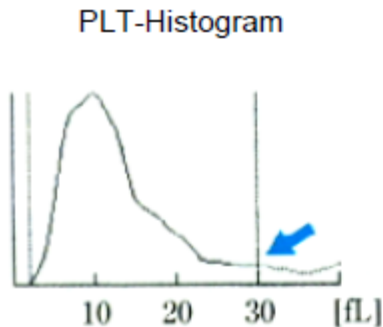


Results

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

Large Platelets

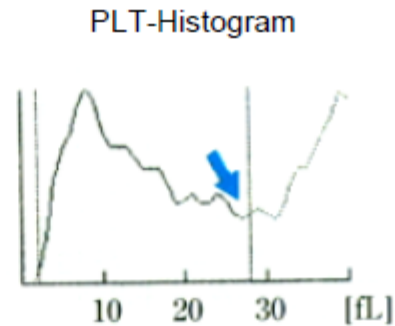
Case 1



Results

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

Case 2

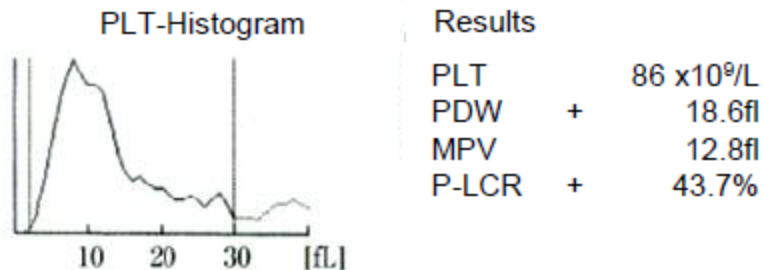
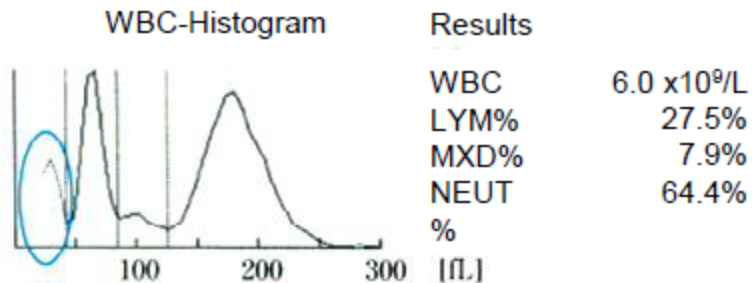


Results

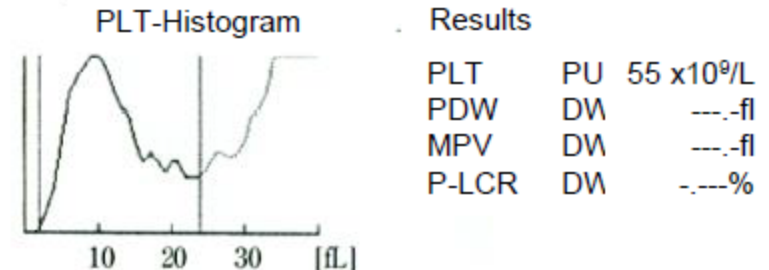
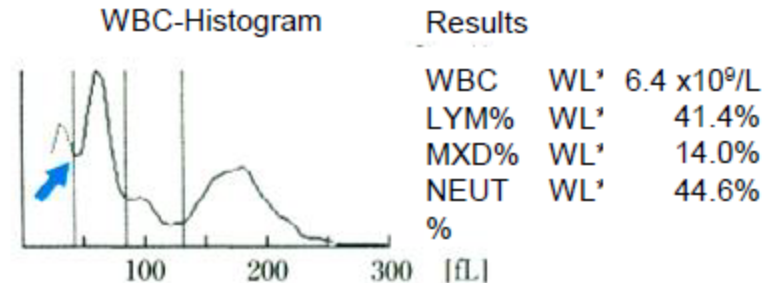
| | | |
|-------|----|------------------------|
| PLT | PU | 71 x10 ⁹ /L |
| PDW | DW | ---.-fl |
| MPV | DW | ---.-fl |
| P-LCR | DW | -.---% |

Platelet Aggregation

Case 1



Case 2





Cold Agglutinins

Incubation 30 min

