TECHNOLOGY AND CASE STUDIES

DxH 500 SERIES HEMATOLOGY ANALYZER

BECKMAN COULTER


Diff
Hct
Neut
MCV
MCHC
MCH
Hgb
Baso
WBC
MPV
PDW
RDW
Mono
Blasts
Sickled Cells
Reticulocyte Count
PMN
Plt
MRV
Eos
Lymph

TABLE OF CONTENTS

The DxH 500 Series System technology for Hematology incorporates the Coulter Principle and Flow cytometric optical measurement to provide an effective and robust technology for cellular analysis.

The Coulter Principle[1]

The Coulter Principle is an electronic method for counting and sizing particles. Although the Coulter Principle can be used to calculate and size just about any particle, the specific application of this principle in hematology is to count and size White Blood Cells (WBC), Red Blood Cells (RBC), and Platelets (PLT).

ELECTRONIC COUNTING AND SIZING BASICS

The Coulter Principle (impedance) is used to count and size cells by detecting and measuring changes in electrical resistance when a particle (such as a cell) is suspended in a conductive liquid and passes through a small aperture. As each cell goes through the aperture, it acts as an insulator and momentarily increases the resistance of the electrical path between the submerged electrodes on either side of the aperture (Figure 1). This causes a measurable electronic pulse. A regulated vacuum is used to pull the diluted cell suspension through the aperture for counting. While the number of pulses indicates particle count, the electrical pulse's size is proportional to the cell volume.

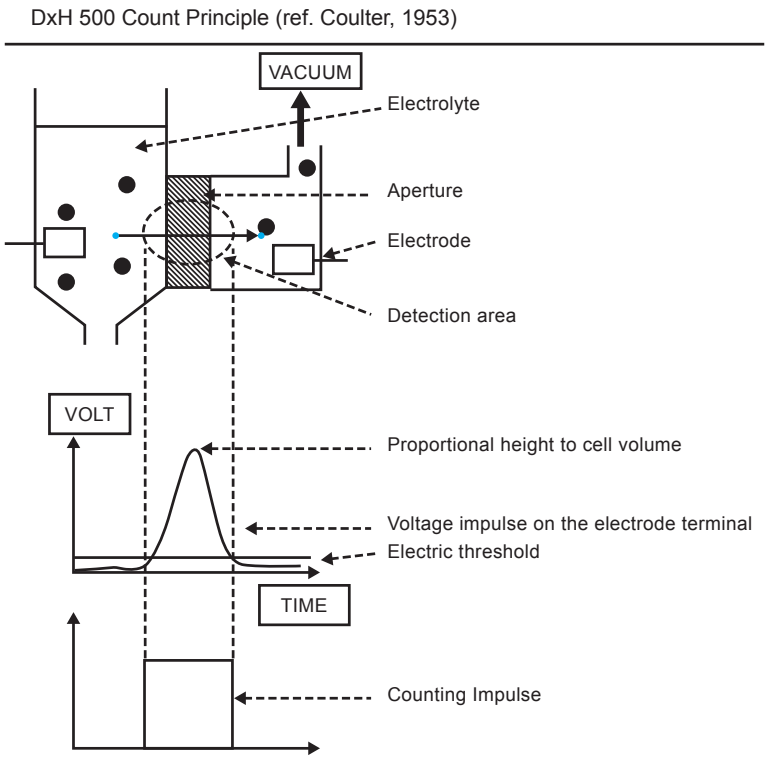


Figure 1. DxH 500 Series Coulter Principle

DxH 500 SERIES SYSTEM OVERVIEW

The DxH 500 Series whole blood sample preparation and count process are detailed below.

- Small amount of whole blood sample is aspirated: DxH 500 - 12µL, DxH 520 and DxH 560 - 17µL (precisely 16.7µL)
- Sample probe retracts, external probe surface is rinsed with DxH 500 Series Diluent
- Sample probe moves above the WBC bath 2.7µL of blood is ejected for the DxH 520 and DxH 560. The sample probe's external surface is rinsed again. The WBC bath is drained
- 1.25mL of DxH 500 Series Diluent is dispensed into the clean and empty WBC bath
- An additional 0.5mL of DxH 500 Series Diluent is dispensed through the sample probe, pushing the sample into the bath and creating the initial dilution of 1: 125 (blood:diluent)
- The WBC dilution is mixed using air bubbles
- Probe aspirate 25µL for the DxH 500 for the RBC dilution. For DxH 520 and DxH 560 the probe aspirate 306uL of the initial WBC dilution that is carried to the shear valve where 25µL is segmented to be used for RBC dilution
- Probe retracts, and the external surface is rinsed
- Meanwhile, 0.66mL of DxH 500 Series Lyse is dispensed into the WBC bath to lyse RBC and create the final WBC dilution (1:182 Blood:Diluent/Lyse)
- The Lysed WBC dilution is air mixed in preparation for analysis, while the RBC Bath is drained
- The WBC dilution is used to count and differentiate the WBCs and hemoglobin measurements
- 2.0mL of DxH 500 Series Diluent is dispensed into the clean and empty RBC bath for the DxH 500
- Additional 2.0mL of DxH 500 Series Diluent is dispensed, pushing the 25µL of the initial WBC dilution into the RBC bath, creating the final RBC dilution of 1:10125
- The RBC dilution is mixed and prepared for the counting and sizing of the RBCs and PLTs
- The system performs two count measurements: The DxH 500 series system Initially counts the CBC (RBC/PLT/WBC) parameters for 3 seconds. The first count is followed by the second measurement of the CBC (RBC/PLT/WBC) parameters + DIFF for 7 seconds
- Vacuum is generated using the dual syringe system
- The syringe system is pre-charged for each counting cycle
- Before all counting cycles, the vacuum level is checked, the generated vacuum is compensated for high altitude
- The apertures are cleaned between counting phase

1. Coulter, WH. High speed automatic blood cell counter and cell size analyzer. Paper presented at National Electronics Conference, Chicago, IL, 1956; October 3.
Also: Coulter, W. High speed automatic blood cell counter and cell size analyzer. In Cytometry (3rd edition). Waltham, MA: Elsevier, 1956.

COUNTING/SIZING

The RBC and WBC counts are determined using the Coulter Principle to count and size cells accurately. The WBC differential is determined using a combination of the impedance WBC data and the direct optical measurement data obtained using a blue Light-emitting diode (LED) focused through the WBC aperture.

COINCIDENCE CORRECTION

More than one cell may occasionally pass through the aperture sensing zone simultaneously. When cells coincide, only one combined pulse is counted. Because the frequency of coincidence is proportional to the actual count, the system automatically corrects results for coincidence.

VOTING

The system prevents data errors due to statistical outliers or obstructions that may block an aperture by voting on WBC, RBC, and PLT data. The system then verifies that the data produced is within an established statistical range and is used to generate parameter results.

SCALING

Scaling adjusts for calibration and reportable format.

PARAMETER DERIVATION

WBC COUNT

The WBC count is measured directly by counting all particles in the WBC dilution. The DxH 500 Series Lytic reagent removes red blood cells. Platelets are removed below a predefined threshold. After performing the coincidence correction, voting, and multiplication by a calibration factor, the final WBC count is provided.

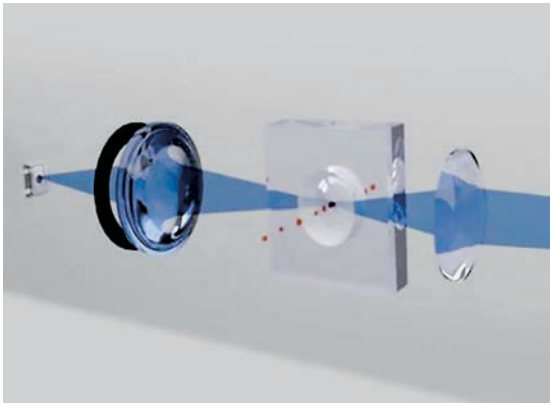


FIGURE 2. DxH 500 Series WBC Differential identified with Coulter Principle technology and Optical measurement

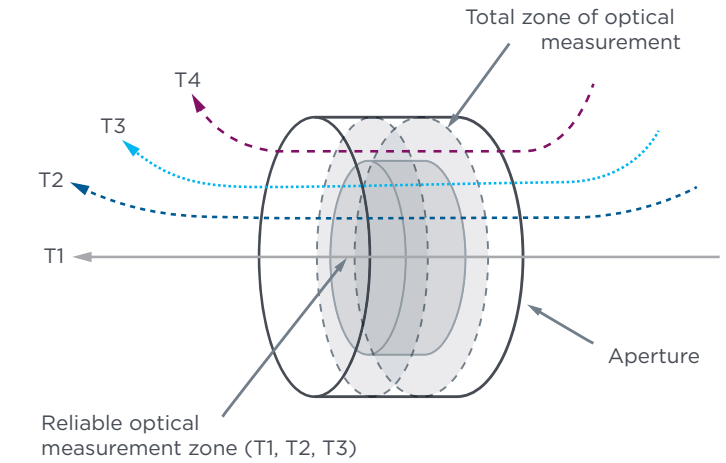
WBC DIFFERENTIAL

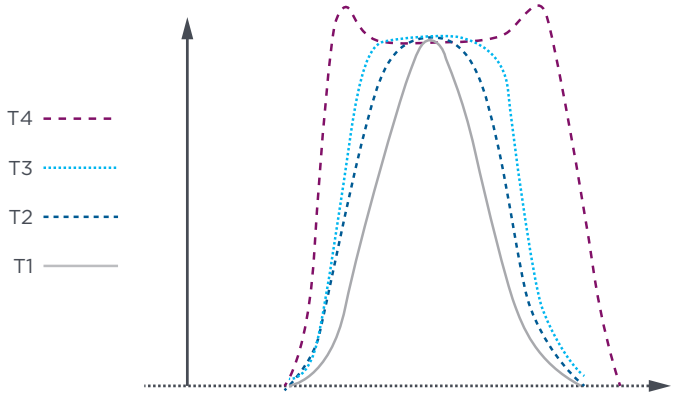
The WBC differential (5-part) is determined using the simultaneous measurements of impedance (volume) and direct optical (Axial Light Loss) within the WBC aperture. The DxH 500 WBC differential technology uses an aperture of proprietary design. The aperture optical assembly is placed perpendicular to the aperture. The LED in the optical assembly projects a blue light through the aperture wall and onto a sensor that detects axial light loss. As cells pass through the aperture, the optical path is interrupted. The amount of light falling on a sensor can be measured and varies depending on cell structure (see Figure 2).

Cells passing through the center of the aperture generate Gaussian pulses by impedance. Cells that are not centered will produce non-Gaussian pulses (see Figure 3).

Gaussian pulses (T1, T2, and T3 in Figure 3) that pass through the center are positioned properly within the aperture for the optical measurement. The DxH 500 series algorithm further analyzes Gaussian pulses and axial light loss to generate the WBC differential, flagging, and messaging.

FIGURE 3. DxH 500 Series WBC Differential Impedance/Optical Measurement



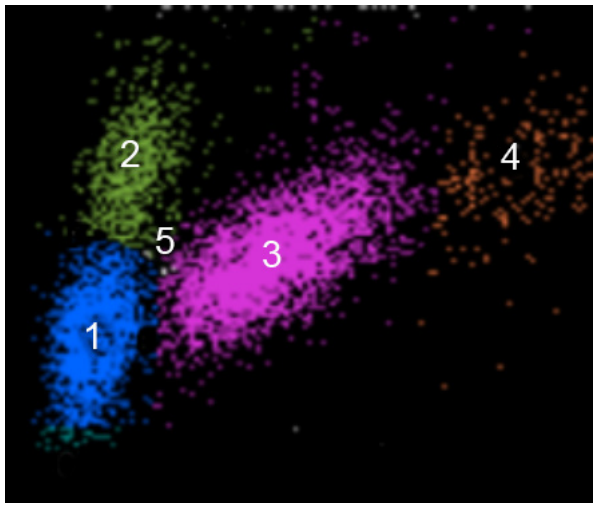


Proprietary pulse processing enables the recognition of data points that fall outside the optimal counting zone. Recognizing these data points as outliers and subsequently removing the unreliable data points enhances cellcount accuracy. Quality results are further improved with dual-count apertures and a wide linearity range for a more comprehensive patient-care capability.

Non-Gaussian pulses (T4 in Figure 3) are discarded.

THE DxH 500 FAMILY APPLIES FLOW CYTOMETRIC OPTICAL ANALYSIS

DxH 500 Series System combines Axial Light Loss (ALL) and Coulter Principle technologies to achieve an accurate leukocyte differential. The DxH 500 Series directly analyzes all white blood cells in an electro-optical flow cytometer module that uses a bright blue LED light source and DC (direct current). The digital information obtained from the WBC analysis is processed through the WBC differential algorithm.



NO.	WBC SUBPOPULATION	COLOR
1	LYMPHOCYTE	BLUE
2	MONOCYTE	GREEN
3	NEUTROPHIL	PURPLE
4	EOSINOPHIL	ORANGE
5	BASOPHIL	WHITE

FIGURE 4. A two-dimensional scatter plot is created with cell volume (Coulter Principle) on the Y-axis and Axial Light Loss on the X-axis. WBC differential data is displayed in the diff plot. The WBC subpopulations are identified by color and intensity (concentration) within the diff plot.

The DxH 500 Series uses simultaneous measurements of cell volume and Axial Light Loss within the WBC aperture to count and size for five major classifications: Lymphocytes, Monocytes, Neutrophils, Eosinophils and Basophils.

A two-dimensional scatterplot is created by placing cell volume on the Y-axis and Axial Light Loss on the X-axis. The LED in the optical assembly projects blue light through the aperture onto a sensor that detects Axial Light Loss when passing cells interrupt the optical path. The amount of light falling on the sensor varies depending on cell structure. The DxH 500 series algorithm generates the WBC differential, flagging and messaging.

HEMOGLOBIN CONCENTRATION

HGB concentration is a directly measured parameter. The released hemoglobin in the WBC bath is converted into stable Oxyhemoglobin (Carboxyhemoglobin, if present). An LED is used to measure the solution by spectrophotometry at λ=545nm. The absorbance of the sample is compared to a blank reading, a calibration factor is applied, and the hemoglobin concentration result is reported.

RBC COUNT

The RBC count is a directly measured parameter, and the RBC dilution contains red blood cells, white blood cells, and platelets. Thresholds separate the smaller platelet pulses from the red and white blood cell pulses.

The white blood cells present in the dilution are included in the red blood cell count. However, their interference is insignificant because there are only a few thousand white blood cells compared to millions of red blood cells. After coincidence correction and voting, the analyzer multiplies the RBC count by a calibration factor and reports the result.

RBC HISTOGRAM

The RBCs are categorized according to size by a pulse-height analyzer. Particles are sorted into 256 (volume) channels to develop a histogram. The display range is approximately 25 to 360fL, and the system monitors the area at the lower end of the histogram for interferences. In interferences, the algorithm will determine the degree of interference and correct the results. The system will flag the results in cases of severe interference.

MEAN CORPUSCULAR VOLUME

The MCV is derived from the RBC histogram. It is the average size of all cells in the RBC histogram. After coincidence correction and voting, the MCV is multiplied by a calibration factor, and the result is reported.

HEMATOCRIT

The HCT is a calculated parameter and is the relative volume of packed erythrocytes to whole blood, expressed as a percentage. . The formula is:

$$\text{HCT (\%)} = \frac{\text{RBC X MCV}}{10}$$

MEAN CORPUSCULAR HEMOGLOBIN

The MCH is calculated and indicates the average weight of hemoglobin in the red blood cell. The formula is:

$$\text{MCH (pg)} = \frac{\text{HGB X 10}}{\text{RBC}}$$

MEAN CORPUSCULAR HEMOGLOBIN CONCENTRATION

The MCHC is an expression of the average concentration of hemoglobin in the red blood cells. It relates the average amount (mass) of hemoglobin in the red blood cells to the red blood cells' average volume. It is computed using the formula.

$$\text{MCHC (g/dL)} = \frac{\text{HGB X 100}}{\text{HCT}}$$

RED CELL DISTRIBUTION WIDTH

The RDW is a measure of the variability in the size of the red cells derived from the RBC histogram. The analyzer uses the cells from the distribution curve to calculate the coefficient of variation of the size of the cells and is expressed as a percentage:

$$\text{RDW} = \frac{\text{Standard Deviation X 100}}{\text{Mean Size}}$$

RED CELL DISTRIBUTION WIDTH—SD

The RDW-SD size is the distribution spread of the erythrocyte population derived from the RBC histogram and expressed as a standard deviation in fL.

PLATELET COUNT

The platelet count is derived from an internal continuous PLT/RBC histogram. Particles between 0 and 70 fL are counted and sized as they pass through the RBC aperture. The raw data is evaluated using proprietary DxH platelet algorithms to identify the platelet population. The system also performs feature analysis to identify patterns of interference at the low and high ends of the PLT histogram. The algorithm uses both the PLT raw data and the fitted histograms for this process to determine PLT interference patterns, correcting or flagging results, depending on the severity of the interference. The platelet histogram's evaluation improves accuracy by excluding interferences from debris, micro bubbles, red cell fragments or exceptionally small red blood cells.

MEAN PLATELET VOLUME

MPV represents the average size of the platelets derived from the platelet histogram. The instrument then multiplies by a calibration factor.

HISTOGRAMS AND DIFF PLOTS

The histograms show relative cell frequency (Y-axis) versus size (X-axis), which provide information about red cell and platelet frequency. A histogram scan provides a means of comparing the sizes of a patient's cells with normal populations.

IMPORTANT

Histograms show only the relative, not actual, number of cells in each size range. Do not estimate the number of cells from the histograms.

Selecting a histogram on the user interface displays a larger view of the histogram. Each histogram is grey with a white background. Each cell population is shaded as follows.

RBC: LIGHT RED

PLT: LIGHT GREEN

FIGURE 5: Normal RBC Histogram

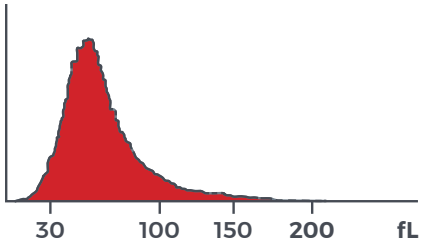
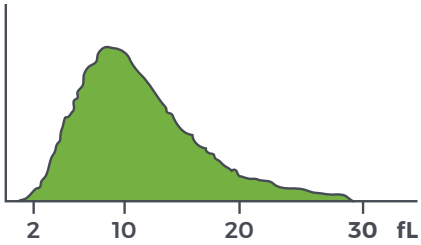


FIGURE 6: Normal PLT Histogram



TYPICAL RBC HISTOGRAM

- The main population is a bell-shaped, symmetrical curve.
- The smallest population to the right of the main population represents the RBC doublets, triplets and WBCs.

Normal characteristics – RBC Histogram

- There is a clear baseline below 50 fL, and the curve is between 50 and 200 fL
- The RBC curve has a slight skew to the right
- There is a clear unimodal mode
- The width of the RBC curve is normal; the RDW is likely normal

TYPICAL PLATELET HISTOGRAM

- The PLT histogram is evaluated for patterns of interference at the low and high ends.
- The internal PLT algorithm uses raw data and fitted histograms to determine the patterns.

Normal characteristics – PLT Histogram

- Log normal
- Low baseline at 2 fL, normally extending to approximately 25 fL
- Positive log-normal distribution
- Mode between 3 and 15 fL

DYNAMIC GATING

PROPRIETARY DYNAMIC-GATING TECHNOLOGY IMPROVES CONFIDENCE IN THE ACCURACY OF 5-PART LEUKOCYTE DIFFERENTIALS WHEN COMPARED TO A STATIC GATE

The DxH 500 Series utilizes sophisticated Dynamic-gating technology improves the identification of leukocyte cell sub-populations by adjusting thresholds in real time between cell-cluster arrangements. With Beckman Coulter's proprietary method, the gates move to more proper cutoffs between cell populations in a series of steps. Improved cutoffs, and subsequently better cell sub-typing are obtained, reducing review (R) flags by 40% in challenging cell populations, such as lymphocytes and eosinophils. This gives a more accurate leukocyte differential than static-gating.

FIGURE 7A: Static-gating

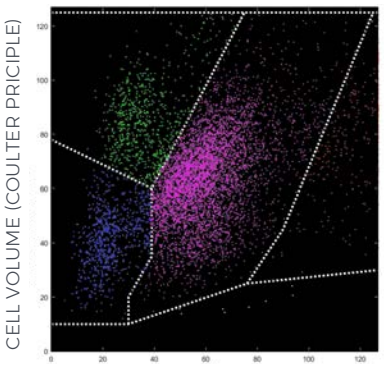
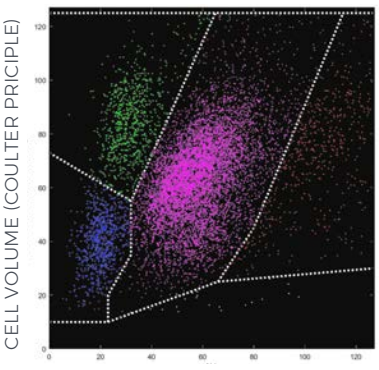


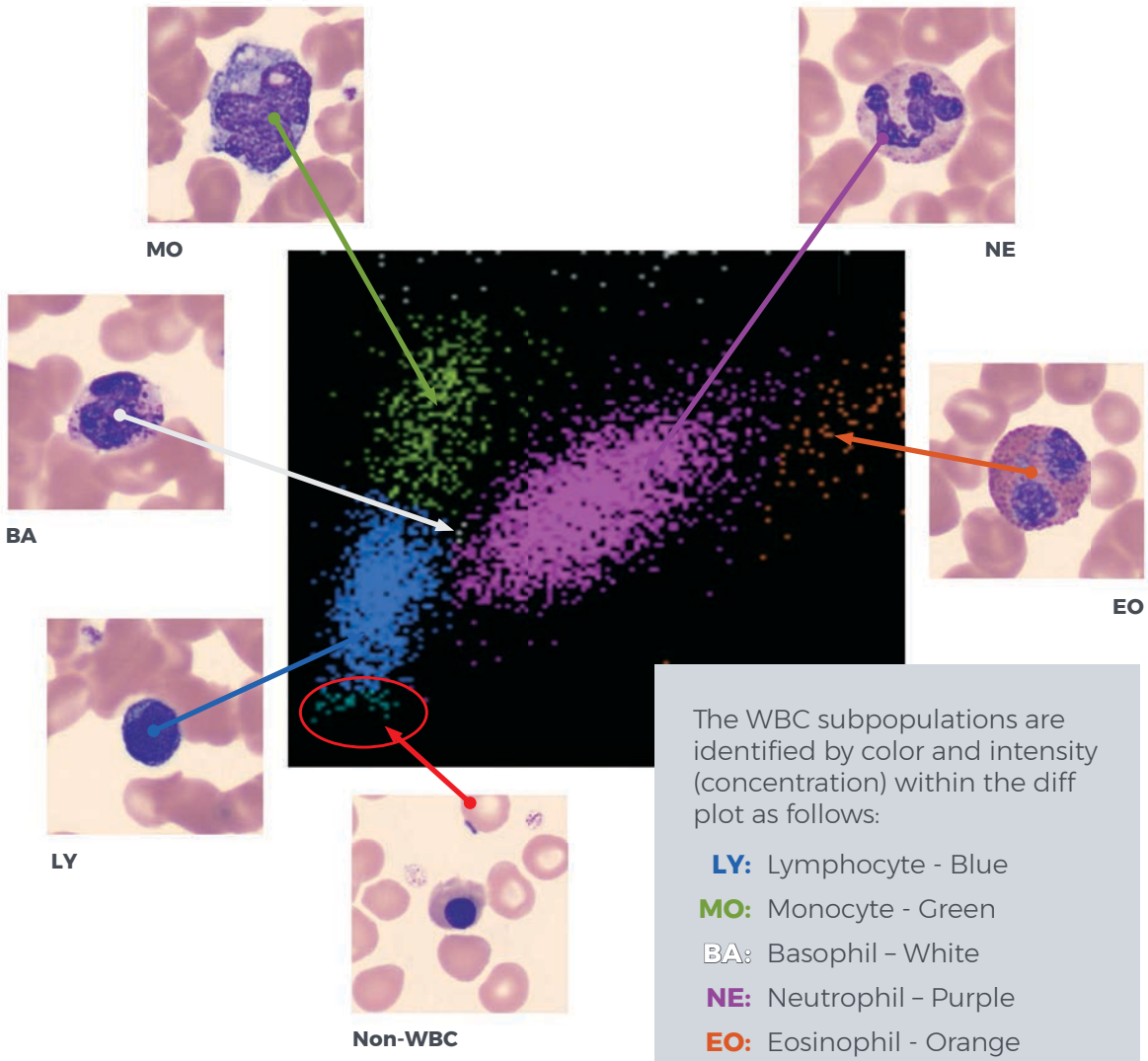
FIGURE 7B: Dynamic-gating



DIFFERENTIAL SCATTER PLOT (DIFF SCATTER PLOT) DEVELOPMENT

The digital information obtained from the WBC differential analysis is processed through the WBC differential algorithm. This information is represented on a 2D scatter plot, with cell volume plotted on the Y-axis and Axial Light Loss (ALL) plotted on the X-axis.

TYPICAL WBC DIFFERENTIAL SCATTER PLOT



The WBC subpopulations are identified by color and intensity (concentration) within the diff plot as follows:

- **LY:** Lymphocyte - Blue
- **MO:** Monocyte - Green
- **BA:** Basophil – White
- **NE:** Neutrophil – Purple
- **EO:** Eosinophil - Orange

DxH 500 SERIES SYSTEM FLAGGING OVERVIEW

Flags, codes, and messages are evaluated when the sample is analyzed. Review the results and pay close attention to any flags, codes, or messages intended to alert you to issues with results or with the instrument. Look for data patterns when examining flags, codes, and messages. Determine if individual or sets of results (for example, WBC and differential results) exhibit flags, codes, and messages. Some flagging occurs due to the flagging or editing of other parameters. In all cases, follow your laboratory's policy for reviewing results.

FLAGS

Flags appear to the right of the parameter result. Flagging occurs as a result of the flagging limits, system messages, or editing of parameters. When flagging limits change, flags are not reevaluated for results already in the database.

The flags shown in the following table are listed in order of priority, from highest to lowest. The columns indicate the three positions where flags appear. It is possible to have flags in all or each of the three positions.

Flag and Position			Description
1	2	3	
E			Manual edit of a primary parameter
e			Automatic edit of a calculated parameter
+			Result is above the analytical measuring range high limit
-			Result is below the analytical measuring range low limit
	R		Review results
	*		Hemoglobin and Hematocrit (H&H) check failure (Hct - 3) < (Hgb*3) < (Hct + 3)
		H	› Patient results above the action limit › Control results above the expected range
		L	› Patient results below the action limit › Control results below the expected range
		h	Patient results above the reference interval, but less than the action limit (H)
		l	Patient results below the reference interval, but less than the action limit (L)

TABLE 1. DxH 500 Series System Flags and Position Description

CODES

Codes are non-numeric characters that appear in place of values when the system cannot generate results.

IMPORTANT

Beckman Coulter recommends that you review all flags and codes according to your laboratory's protocol.

The codes in the following table are listed from highest to lowest priority.

Code	Description
-----	Total vote out (dashes). Inconsistent data between count periods.
•••••	Incomplete computation (dots). Data cannot be derived.
+++++	Above operating range (plus signs).
?????	Result is outside the range of values that can be formatted for display (question marks).

TABLE 2. DxH 500 Series System Codes

SYSTEM MESSAGES

All messages are accompanied by R (Review) flags or other flags. A system message indicates an event occurrence that may affect the operation of the system, require operator notification, or entry into an Event Log.

Refer to Table 3 and Figures 8, 9 and 10 for all System Messages.

IMPORTANT

Beckman Coulter recommends that you review and handle all messages according to your laboratory's protocol.

For a complete list of technical information and messages please reference the following IFU's

Instrument	IFU Reference Number
DxH 500	DxH 500 PN B95837
DxH 520	DxH 520 PN B85528
DxH 560	DxH 560 Autoloader C48648 (US Only) DxH 560 Autoloader C31608 (Outside of the US)

System Message	Description
BA Interference	Multiple populations are overlapped. Cannot calculate BA%. The R flag appears next to Diff % and # results. A non-numeric (.....) appears for BA% and BA#.
Cellular Interference	Poor separation between WBC population and interference in the lower lymphocyte area. The R flag appears next to WBC and/or Plt, and Diff %/# results. The number of cells is below the WBC count threshold.
Debris	Too many events in the debris area.
Dimorphic RBC	Evidence of the presence of at least two populations of red cells. The RBC Histogram flags affect the RDW results. This flag is inhibited when both WBC and RBC are less than the measuring range, or when the RBC result is non-numeric (+++++ or .....). The R flag appears next to RDW and RDW-SD.
H & H Check Failed	The ratio of HGB to HCT is not in the expected range (Hct - 3) < (Hgb*3) < (Hct + 3). The * flag appears next to HGB, HCT, and the computed related results.
Hgb Blank Error	HGB blank reading is outside the internal threshold limits. The HGB and computed result is non-numeric (.....).
Large Cells	High number of events in the large cell area. The R flag appears next to Diff % and # results.
Low Diff Events	Not enough good white events during Diff analysis. The scatter plot total numbers of cells is less than 500. The R flag appears next to Diff % and # results.
LY/MO Overlap	Lymphocyte and Monocyte populations are overlapped. The R flag appears next to Diff % and # results.
MO/NE Overlap	Monocyte and Neutrophil populations are overlapped. The R flag appears next to Diff % and # results.
NE/LY Overlap	Neutrophil and Lymphocyte populations are overlapped. The R flag appears next to Diff % and # results.
NE/EO Overlap	Neutrophil and Eosinophil populations are overlapped. The R flag appears next to Diff % and # results.
PLT1 – Debris	Interference with smaller platelets. Interference at the left side of the PLT histogram between channel 0 and the CP1 threshold.
PLT2 – Debris	Interference with larger platelets. Interference at the right side of the PLT histogram between the CP2 and P thresholds.
PLT3 PLT/RBC Overlap	PLT and RBC populations are overlapped between the CP3 and CP3-2 thresholds.
WBC/DIFF Carryover	The estimated WBC carryover, based on the WBC value from the preceding sample and the expected WBC carryover percent, may significantly affect the WBC results for the current specimen. The R flag appears next to WBC, Diff % and # results.
PLT Carryover	The estimated PLT carryover, based on the PLT value from the preceding sample and the expected PLT carryover percent, may significantly affect the PLT results for the current specimen. The R flag appears next to PLT and related results.
RBC Aggregates	MCH, RDW, and RDW-SD all exceed threshold limits. The R flag appears next to RBC, MCH, RDW, and RDW-SD.

TABLE 3. System Messages

SYSTEM MESSAGES – RBC AND PLT HISTOGRAMS

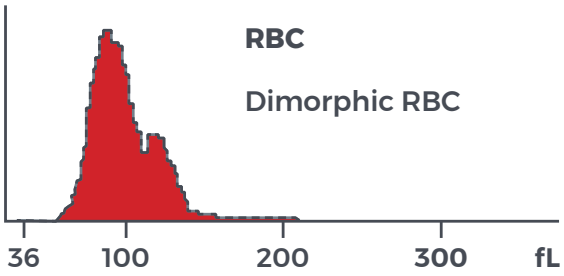


FIGURE 8: RBC Histogram Messages

PLT HISTOGRAM THRESHOLD LIMITS

The PLT histogram has four fixed thresholds (CP1, CP2, CP3, and CP3-2) and one variable threshold (P) that moves based on the presence of interference.

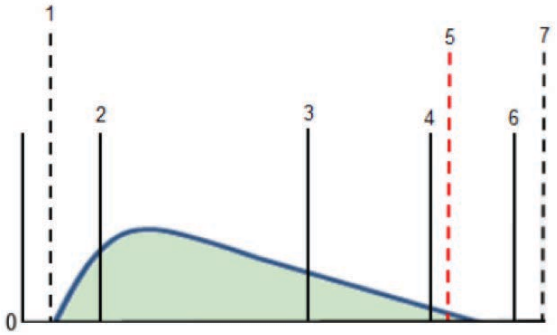


FIGURE9:. PLT Histogram Threshold Limits

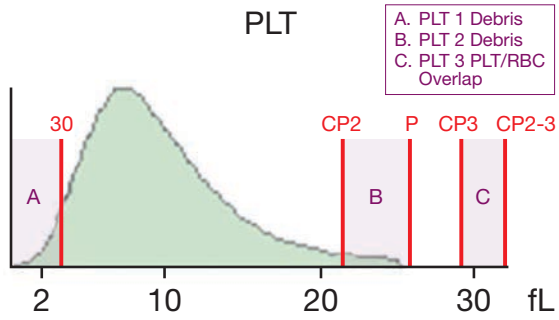


FIGURE 10. PLT Histogram Messages

No.	Threshold	Appropriate Volume (fL)
1	Minimum PLT	2.0
2	CP1	5.0
3	CP2	18.0
4	P	27.0*
5	Minimum RBC	28.0
6	CP3	32.0
7	Maximum PLT/ CP3-2	34.0

*P is a variable (moving) threshold

PLT1 DEBRIS: Low-end interference; microbubbles, electronic noise

PLT2 DEBRIS: Large platelets, clumped platelets, fragmented RBC

PLT 3 PLT/RBC OVERLAP: Microcytic RBC, Large platelets

DIFFERENTIAL SCATTER PLOT FLAGGING AREAS

Populations that are normally separated generate flags or messages when internal criteria for separation is exceeded. The following figure is a normal population with good separation. Depending on the region of the scatter plot, the presence of too many particles or an unclear separation between populations will trigger a message that informs you of the need to review the differential.

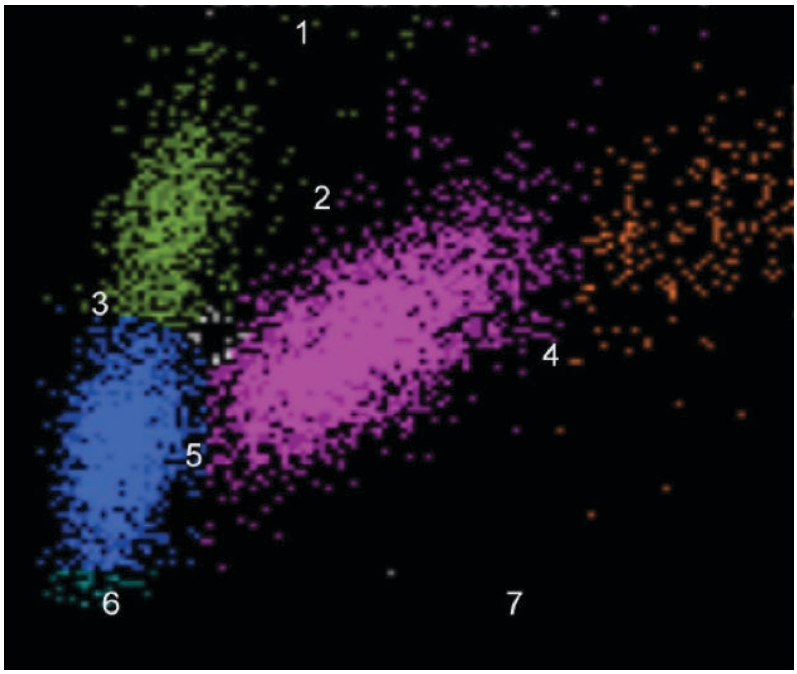


Figure 8. Differential Scatter Plot Flagging Regions

No.	Flagging Region	Message
1	Large Immature Cell	Large Cells
2	MN (Monocyte/Neutrophil)	MO/NE Overlap
3	LM (Lymphocyte/Monocyte)	LY/MO Overlap
4	NE (Neutrophil/Eosinophil)	NE/EO Overlap
5	NL (Neutrophil/Lymphocyte)	NE/LY Overlap
6	LLYM (Lower Lymphocyte)	Cellular Interference
7	Debris	Debris

MESSAGES

Messages are displayed in the Messages box on the Sample Analysis - Patient Results screen. Messages are generated when specimen results meet certain conditions or an event occurs that may affect the operation of the system, the quality of results, or when operator intervention is required. Messages may be accompanied by R (Review) flags, other flags, or codes.

Message	Message	Description
BA Interference	Diff % R,	Diff# R Cannot calculate BA. A non-numeric result (.....) appears for BA and BA#. Multiple populations are overlapped for monocyte, neutrophil, and lymphocyte regions (NL, LM, MN). Abnormal Diff appears with this message when a CD is ordered.
Background Failed	All Results R	Specimen processed after Background has failed.
Cellular Interference	WBC R, Diff % R, Diff # R, PLT R	Poor separation between WBC populations and interference below the lymphocytes area. Abnormal Diff appears with this message when a CD is ordered.
Daily Checks Failed	All Results R	Specimen processed after Daily Checks has failed.
Debris	None	Too many events in the Debris area.
Dimorphic RBC	RDW R, RDW-SD R	Evidence of the presence of at least two populations of red cells.
Expired Cleaner	All Results R	Specimen processed with expired Cleaner.
Expired Diluent	All Results R	Specimen processed with expired Diluent.
Expired Lyse	All Results R	Specimen processed with expired Lyse.
H&H Check Failed	HGB*, HCT*, MCH*, MCHC*, RDW*, RDW-SD*	The ratio of HGB to HCT is not in the expected range.
HGB Blank Error	HGB..... , HCT..... , MCH..... , MCHC..... , RDW..... , RDW-SD.....	HGB blank reading exceeds the internal threshold limits.
HGB Out of Range Error	HGB....., HCT....., MCH*, MCHC*, RWD*, RDW-SD*	HGB calculation is not within internal range.
Instrument Temperature Out of Range	All Results R	Specimen processed when the instrument temperature is not within specification.
Large Cells	Diff % R, Diff # R	High number of events in the Large Immature Cell area. Abnormal Diff appears with this message when a CD is ordered.
Low Diff Events	Diff % R, Diff # R	The scatter plot total number of cells is less than 500.
LY/MO Overlap	Diff % R, Diff # R	Lymphocyte and Monocyte populations are overlapped in the LY/MO threshold area. Abnormal Diff appears with this message when a CD is ordered.

Message	Message	Description
MO/NE Overlap	Diff % R, Diff # R	Monocyte and Neutrophil populations are overlapped in the MO/NE threshold area. Abnormal Diff appears with this message when a CD is ordered.
NE/LY Overlap	Diff % R, Diff # R	Neutrophil and Lymphocyte populations are overlapped in the NE/LY threshold area. Abnormal Diff appears with this message when a CD is ordered.
NE/EO Overlap	Diff % R, Diff # R	Neutrophil and Eosinophil populations are overlapped in the NE/EO threshold area. Abnormal Diff appears with this message when a CD is ordered.
Optical Adjust Failed	Diff %..... , Diff #.....	Optical LED adjust failed (out of range 27,500 +/- 3%).
Optical LED Mean Error	WBC..... , Diff %..... , Diff #.....	Axial Light Loss mean is less than the defined limit.
Optical LED Value Error	WBC	Axial Light Loss value for at least one count period is lower than the default limit.
PLT1:Debris	PLT R, MPV R	Interference with smaller platelets. Interference at the left side of the PLT histogram is between channel 0 and the CP1 threshold.
PLT2:Debris	PLT R, MPV R	Interference with larger platelets. Interference is at the right side of the PLT histogram between the CP2 and P thresholds.
PLT3: PLT/RBC Overlap	PLT R, MPV R	PLT and RBC populations are overlapped between the CP3 and CP3-2 thresholds.

DEFINITIVE MESSAGES

Definitive messages are displayed in the Messages box. Definitive messages appear based on limits you have selected as reference intervals or action limits.

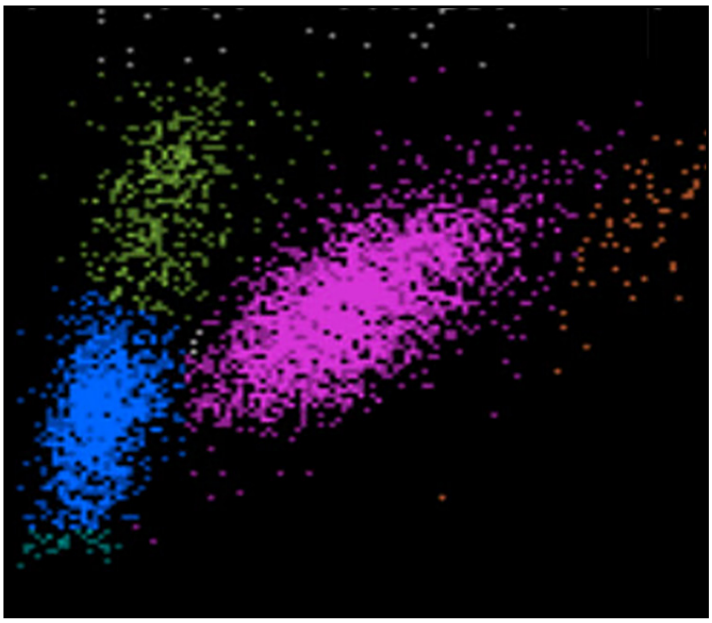
Message	Description
Anemia	Low RBC and/or Low HGB
Anisocytosis	High RDW
Basophilia	High BA and/or #
Eosinophilia	High EO and/or #
Erythrocytosis	High RBC
Hypochromia	Low MCH
Large Platelets	High MPV
Leukocytosis	High WBC
Leukopenia	Low WBC
Lymphocytosis	High LY and/or #
Lymphopenia	Low LY and/or #
Macrocytosis	High MCV
Microcytosis	Low MCV
Monocytosis	High MO and/or #
Neutropenia	Low NE and/or #
Neutrophilia	High NE and/or #
Small Platelets	Low MPV
Thrombocytopenia	Low PLT
Thrombocytosis	High PLT

CASE 1 | NORMAL

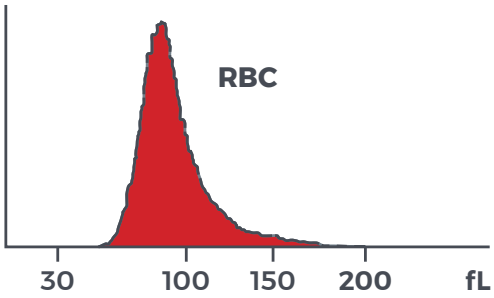
› No instrument codes, flags and messages observed

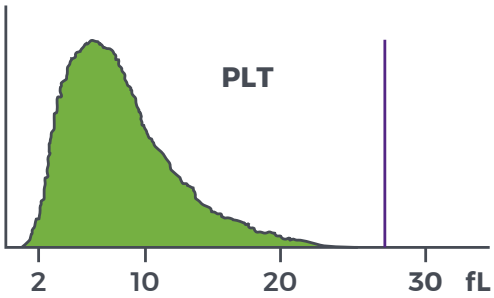
› Scatter plot and histogram populations appear normal

DxH 500 SERIES SCATTER PLOT



The scatter plot and histogram populations appear normal.



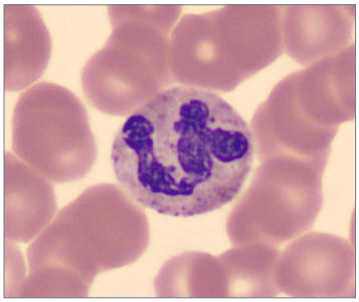
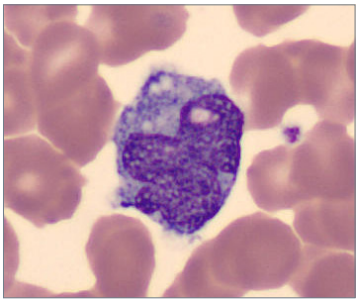
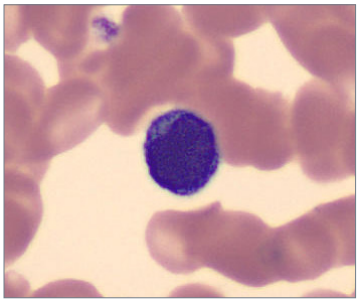
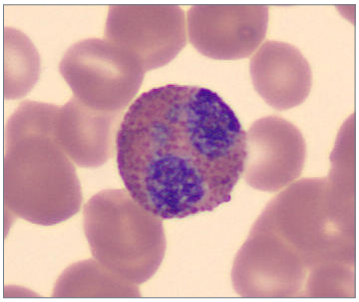
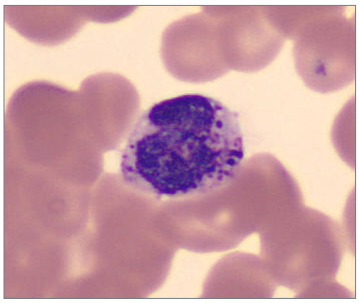


WBC DIFFERENTIAL RESULTS			
WBC	4.9		x10³/µL
LY	26.5		%
MO	8.6		%
NE	63.0		%
EO	1.8		%
BA	0.1		%
LY#	1.3		x10³/µL
MO#	0.4		x10³/µL
NE#	3.1		x10³/µL
EO#	0.1		x10³/µL
BA#	0.0		x10³/µL

RBC RESULTS			
RBC	5.07		x10⁶/µL
HGB	16.2		g/dL
HCT	47.4		%
MCV	93.4		fL
MCH	32.0		pg
MCHC	34.2		g/dL
RDW	12.7		%
RDW-SD	40.4		fL

PLT RESULTS			
PLT	228.7		x10³/µL
MPV	8.4		fL

BLOOD SMEAR (CELLAVISION™)

MANUAL DIFFERENTIAL	
BLASTS	
PROMYELOCYTES	
MYELOCYTES	
METAMYELOCYTES	
BANDS	
SEGMENTED NEUTROPHILS	61.0
EOSINOPHILS	3.0
BASOPHILS	2.0
PROLYMPHOCYTES	
LYMPHOCYTES	29.0
ATYPICAL LYMPHOCYTES	
PROMONOCYTES	
MONOCYTES	5.0
PLASMA CELLS	
NRBCS	

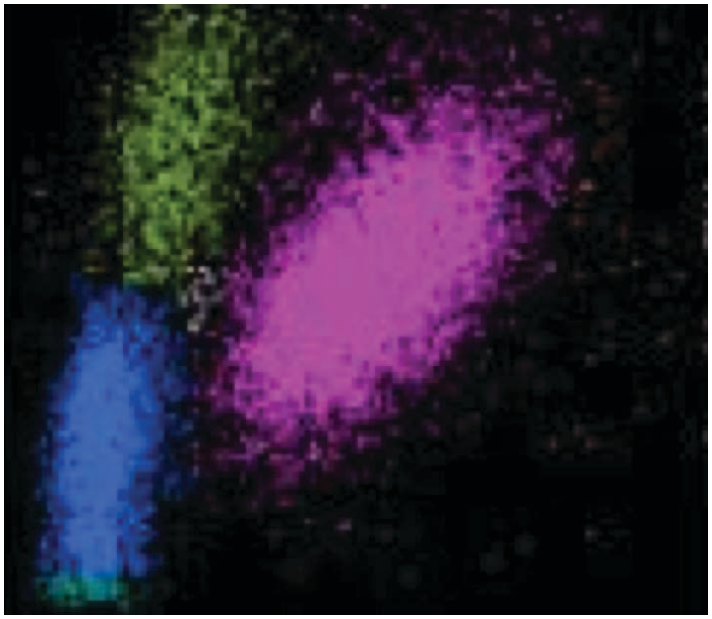
SUMMARY RESULTS

- All values are within reference ranges
- This case illustrates a sample with normal results and no observed abnormalities

CASE 2 | SICKLE CELL ANEMIA

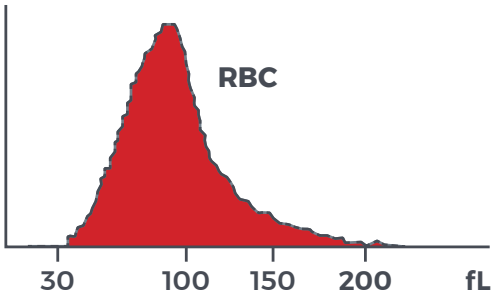
CBC parameters indicate leukocytosis and normocytic anemia with anisocytosis. WBC results show lymphocytosis, monocytosis and neutrophilia. Differential scatter plot displays population of cells extending from the Lymphocyte region into Cellular Interference region.

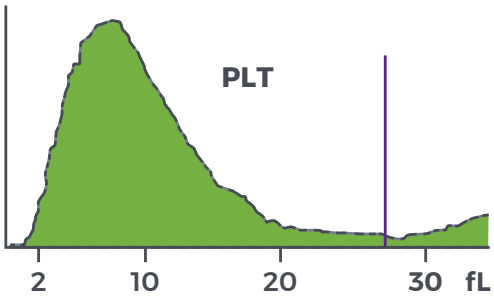
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Suspect Diff



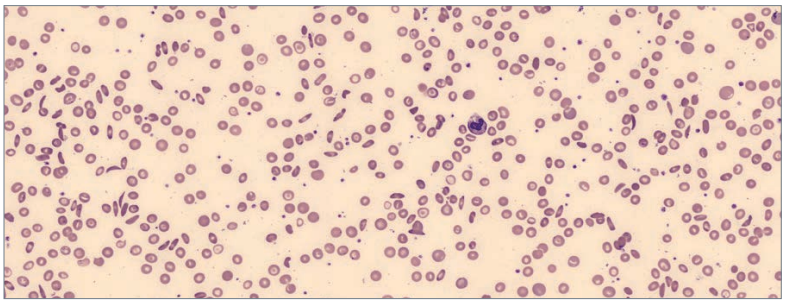


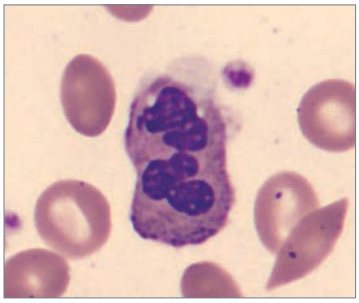
WBC DIFFERENTIAL RESULTS			
WBC	15.56	h	x10³/µL
LY	21.09		%
MO	10.53		%
NE	67.66		%
EO	0.49	l	%
BA	0.24		%
LY#	3.28	h	x10³/µL
MO#	1.64	H	x10³/µL
NE#	10.53	h	x10³/µL
EO#	0.08		x10³/µL
BA#	0.04		x10³/µL

RBC RESULTS			
RBC	1.97	l	x10⁶/µL
HGB	6.20	L	g/dL
HCT	18.8	L	%
MCV	95.3		fL
MCH	31.5		pg
MCHC	33.0		g/dL
RDW	21.0	h	%
RDW-SD	63.2	h	fL

PLT RESULTS			
PLT	295.6		x10³/µL
MPV	10.52		fL

BLOOD SMEAR (CELLAVISION™)





MANUAL DIFFERENTIAL	
NEUTROPHILS	62.2
BAND NEUTROPHILS	2.6
LYMPHOCYTES	22.6
MONOCYTES	8.4
EOSINOPHILS	3.4
BASOPHILS	0.5
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	1.0

COMMENTS

RBC: Macrocytosis

PLT: Occational PLT clumps

SUMMARY RESULTS

- The blood film confirms the leukocytosis and normocytic normochromic anemia with anisocytosis
- Very abundant sickle cells on the peripheral blood smear as well as some RBC inclusions type Howell Jolly bodies suggesting either a splenectomy or spleen infarctions caused by the sickle cells

DIAGNOSIS: SICKLE CELL ANEMIA | CLS-129 20 MALE SICKLE CELL ANEMIA

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

- Hemoglobin SS disease is the most common type of sickle cell disease
- Severe hemolytic anemia punctuated by crises

Crises may be

- Vaso-occlusive crises
- Visceral sequestration crises
- Aplastic crises
- Hemolytic crises

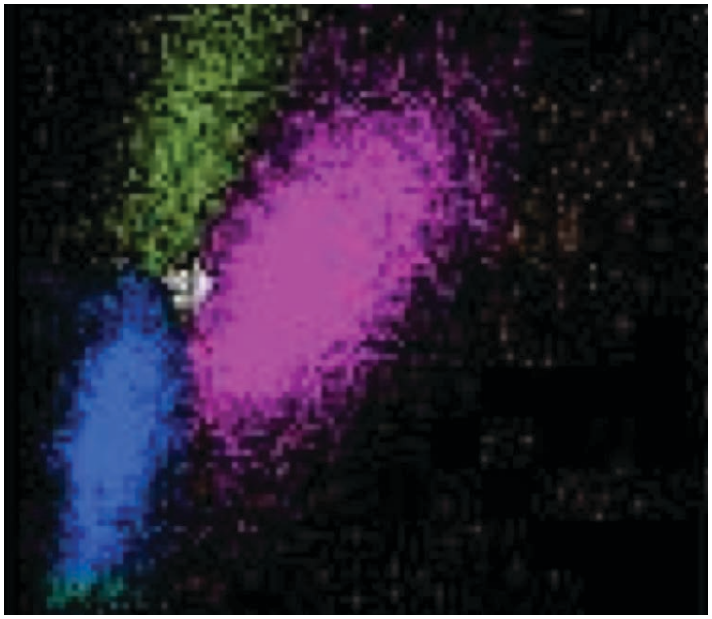
LABORATORY FINDINGS

- The HGB is usually 6-9 g/dL
- Sickle cells and target cells occur in the blood
- Screening tests are positive when the blood is deoxygenated
- HPLC or hemoglobin electrophoresis in Hb SS: no Hb A is detected, and the amount of Hb F is variable and is usually 5-15%

CASE 3 | MICROCYTIC ANEMIA WITH THROMBOCYTOSIS

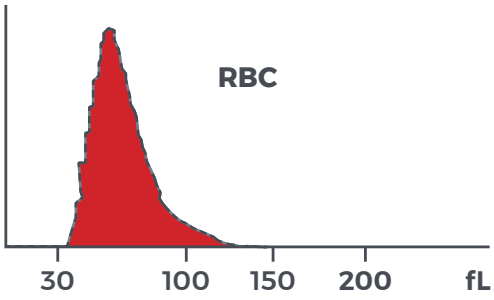
CBC parameters indicate leukocytosis and microcytic hypochromic anemia with anisocytosis. Thrombocytosis, platelet histogram demonstrates population of cells beyond 30 fl, which corresponds to microcytic RBC. WBC results show neutrophilia and monocytosis. Differential scatter plot displays population of cells extending from the Lymphocyte region into Cellular Interference region

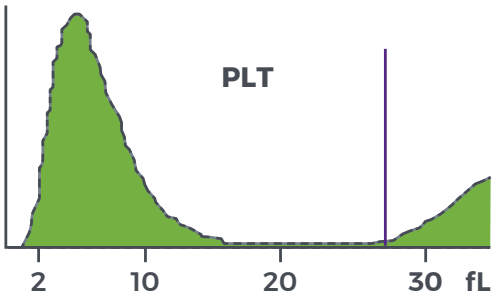
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Suspect Diff



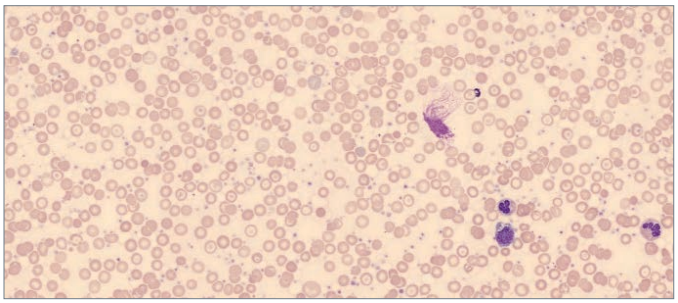


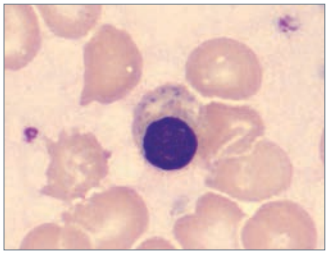
WBC DIFFERENTIAL RESULTS			
WBC	16.46	h	x10³/µL
LY	18.31		%
MO	10.80		%
NE	68.97		%
EO	1.29	l	%
BA	0.63		%
LY#	3.01		x10³/µL
MO#	1.78	H	x10³/µL
NE#	11.35	h	x10³/µL
EO#	0.21		x10³/µL
BA#	0.10		x10³/µL

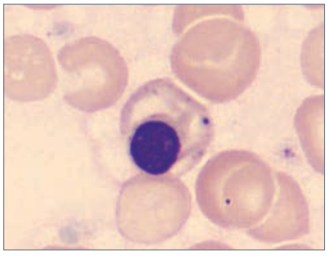
RBC RESULTS			
RBC	3.56	l	x10⁶/µL
HGB	6.85	L	g/dL
HCT	22.9	l	%
MCV	64.3	L	fL
MCH	19.2	l	pg
MCHC	29.9	L	g/dL
RDW	21.0	h	%
RDW-SD	44.5		fL

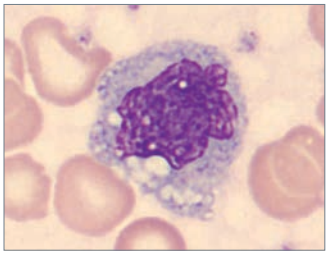
PLT RESULTS			
PLT	1382.3	H	x10³/µL
MPV	7.62		fL

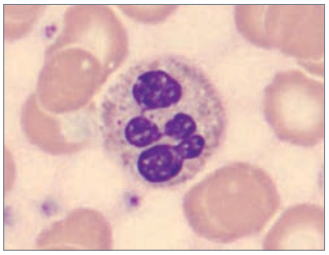
BLOOD SMEAR (CELLAVISION™)

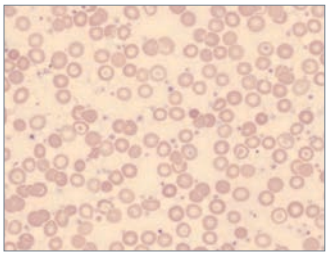


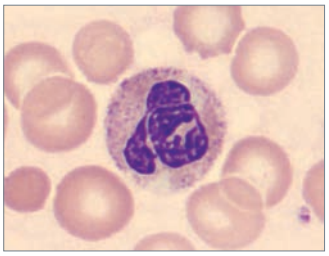


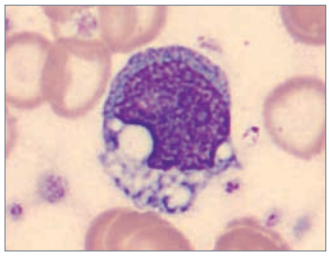


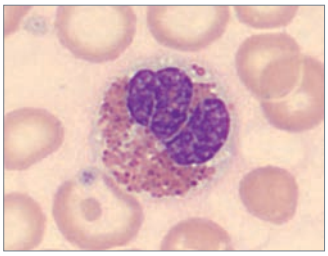












MANUAL DIFFERENTIAL	
NEUTROPHILS	64.0
BAND NEUTROPHILS	3.7
LYMPHOCYTES	19.05
MONOCYTES	11.8
EOSINOPHILS	1.0
BASOPHILS	
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	1.0

SUMMARY RESULTS

› The peripheral blood film shows hypochromic, microcytic RBCs alongside abundant target cells and thrombocytosis

› The white blood cell differential confirms the analyzer's results

DIAGNOSIS: MICROCYTIC ANEMIA WITH THROMBOCYTOSIS | IUH-172 26 MALE GENERAL SYMPTOMS PAIN

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

In this possible anemic syndrome with an underlying iron deficiency anemia the patient may present with

- Dizziness, confusion and loss of concentration, sadness and/or depression
- Tachycardia, short breath and palpitations
- Asthenia, pallor and feeling cold

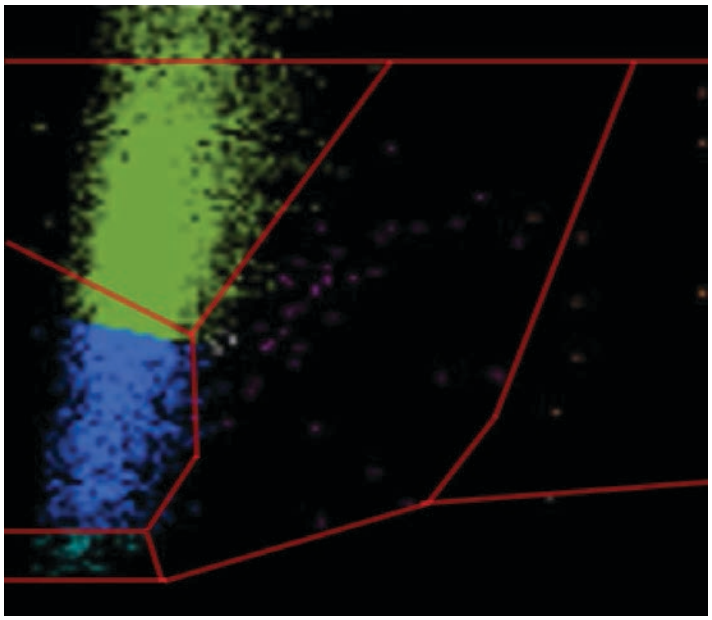
LABORATORY FINDINGS

- Hb < 10 g/dL
- Hypochromic, microcytic anemia
- Anisocytosis

CASE 4 | ACUTE MYELOID LEUKEMIA WITH THROMBOCYTOPENIA

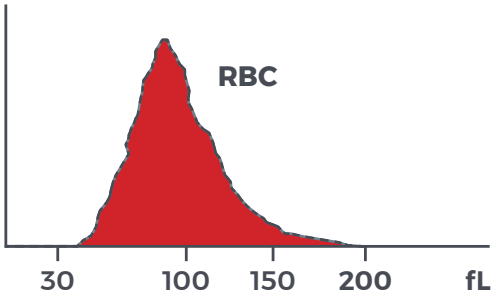
CBC parameters indicate leukocytosis and normocytic anemia with anisocytosis. RBC histogram is wide, with some macrocytic RBC. Thrombocytopenia with abnormal Plt histogram, but Plt count is reported without flags. Differential scatterplot displays single population of cells extending from the Lymphocyte region into the Monocyte region, and from the Lymphocyte region into the Cellular Interference region, as indicated by multiple instrument messages. Presence of abnormal large cells can be suspected as indicated by the message "Large cells". Differential results are flagged for review.

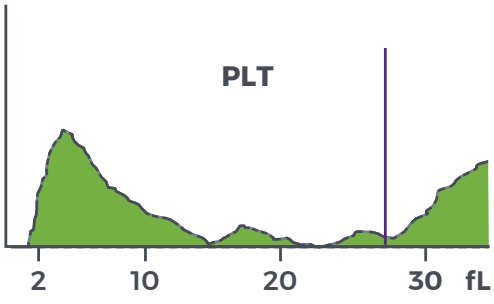
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

FLAGS: Abnormal Diff | Suspect Diff | LY/MO Overlap | Large Cells



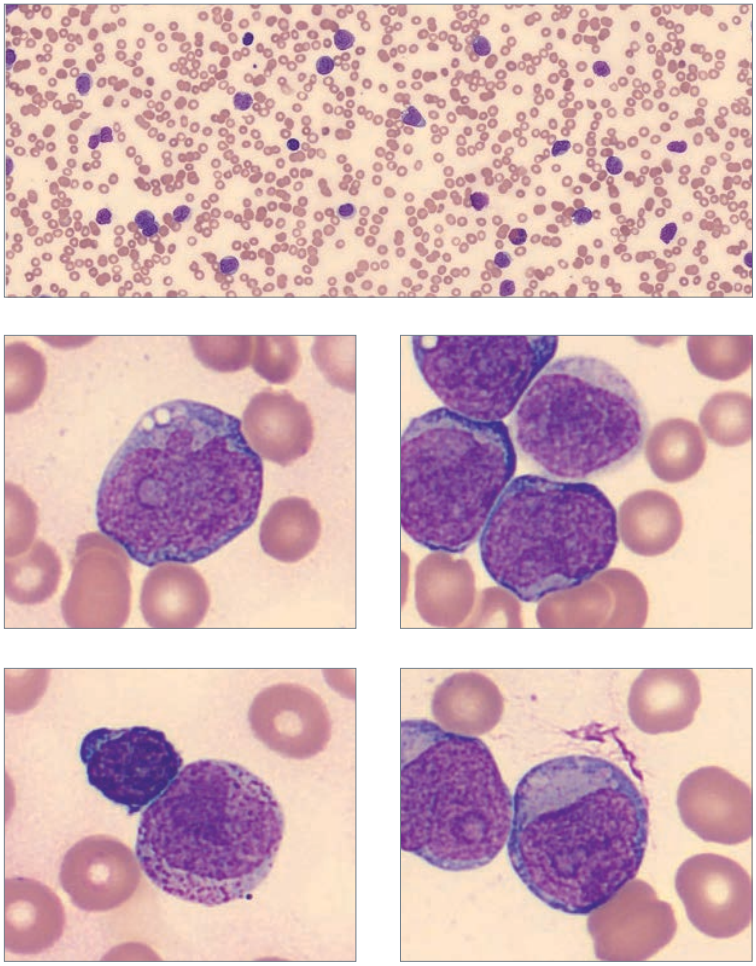


WBC DIFFERENTIAL RESULTS			
WBC	62.68	H	x10³/µL
LY	17.42	R	%
MO	81.94	Rh	%
NE	0.46	Rl	%
EO	0.10	Rl	%
BA	0.07	Rl	%
LY#	10.92	RH	x10³/µL
MO#	51.36	RH	x10³/µL
NE#	0.29	Rl	x10³/µL
EO#	0.06	R	x10³/µL
BA#	0.04	R	x10³/µL

RBC RESULTS			
RBC	2.33	I	x10⁶/µL
HGB	7.45	L	g/dL
HCT	22.4	I	%
MCV	96.1		fL
MCH	32.0		pg
MCHC	33.3		g/dL
RDW	19.4	h	%
RDW-SD	69.3	h	fL

PLT RESULTS			
PLT	15.2	L	x10³/µL
MPV	9.78		fL

BLOOD SMEAR (CELLAVISION™)



MANUAL DIFFERENTIAL	
NEUTROPHILS	0.5
BAND NEUTROPHILS	
LYMPHOCYTES	17.8
MONOCYTES	1.7
EOSINOPHILS	0.8
BASOPHILS	
METAMYELOCYTES	0.2
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	70.6
NRBC	

COMMENTS

1+ Aniso, 1+ Macro, 1+ Poikilocytosis

SUMMARY RESULTS

Critical thrombocytopenia with almost no platelets observed under the microscope. The manual differential confirms a very high percentage of blasts and critical neutropenia.

DIAGNOSIS: ACUTE MYELOID LEUKEMIA (AML) WITH THROMBOCYTOPENIA

IUH-158 58 FEMALE LEUKEMIA (ACUTE MYELOID)

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

Abnormal bleeding associated with thrombocytopenia or abnormal platelet function is characterized by spontaneous skin purpura and mucosal hemorrhage and prolonged bleeding after trauma. The main causes of thrombocytopenia are:

- Failure of platelet production as part of general bone marrow failure following malignant neoplasms
- Increased consumption of platelets as in the immune thrombocytopenia or disseminated intravascular coagulation
- Abnormal distribution of platelets in patients with splenomegaly

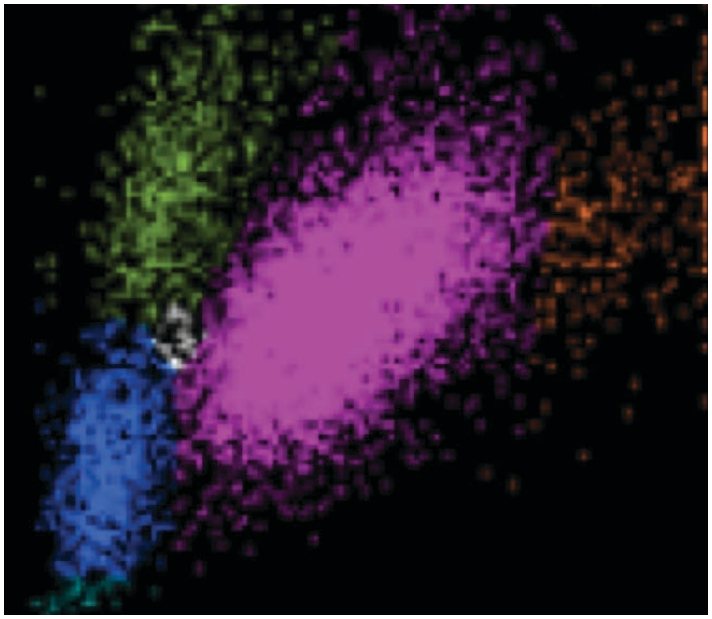
LABORATORY FINDINGS

- The platelet count is usually 10-100 x 10^3/µL
- The blood film shows reduced numbers of platelets
- The bone marrow may show a reduced or increased numbers of megakaryocytes depending whether the cause of thrombocytopenia is central or peripheral

CASE 5 | THROMBOCYTOSIS

CBC parameters indicate leukocytosis and microcytic anemia with anisocytosis. WBC results show monocytosis and neutrophilia. Differential scatterplot appears normal although with predominant population of neutrophils. Thrombocytosis, platelet histogram appears normal.

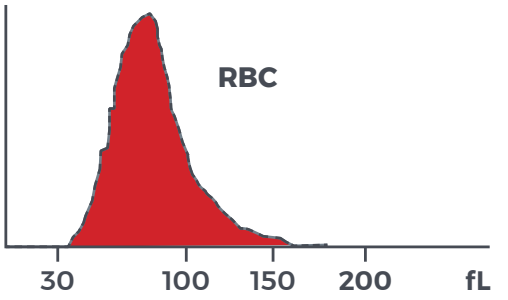
DxH 500 SERIES SCATTER PLOT

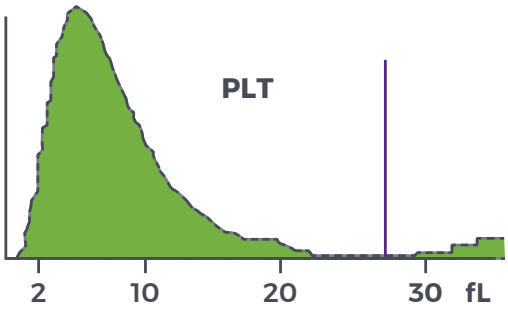


WBC DIFFERENTIAL RESULTS			
WBC	14.65	h	x10³/µL
LY	9.53	l	%
MO	7.68		%
NE	79.83	h	%
EO	2.51		%
BA	0.45		%
LY#	1.40		x10³/µL
MO#	1.13	h	x10³/µL
NE#	11.70	h	x10³/µL
EO#	0.37		x10³/µL
BA#	0.07		x10³/µL

FLAGS AND MESSAGES

Flags:

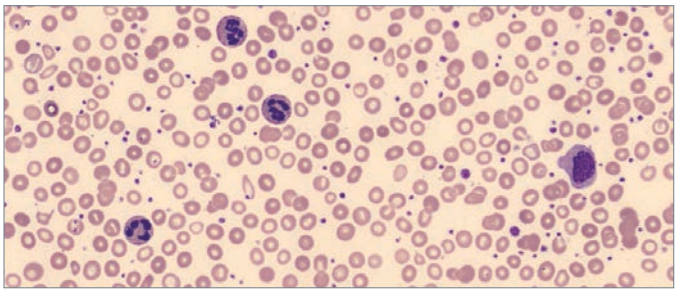


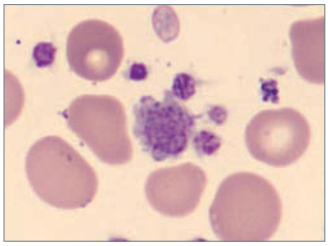


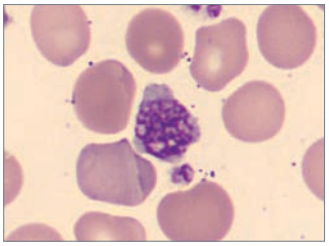
RBC RESULTS			
RBC	3.56	l	x10⁶/µL
HGB	9.05	l	g/dL
HCT	28.3	l	%
MCV	79.5		fL
MCH	25.4		pg
MCHC	32.0	l	g/dL
RDW	20.0	h	%
RDW-SD	54.2	h	fL

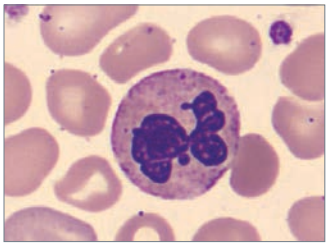
PLT RESULTS			
PLT	1193.1	H	x10³/µL
MPV	8.45		fL

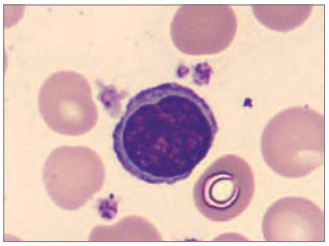
BLOOD SMEAR (CELLAVISION™)







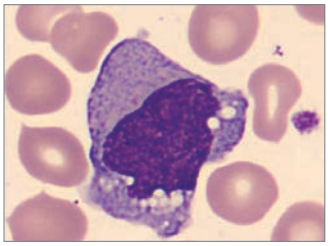


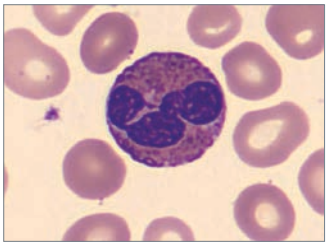


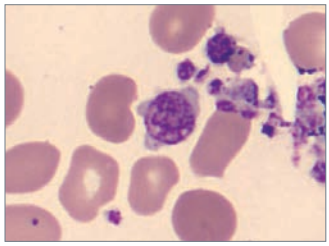
MANUAL DIFFERENTIAL	
NEUTROPHILS	78.1
BAND NEUTROPHILS	
LYMPHOCYTES	9.8
MONOCYTES	6.0
EOSINOPHILS	3.0
BASOPHILS	
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	

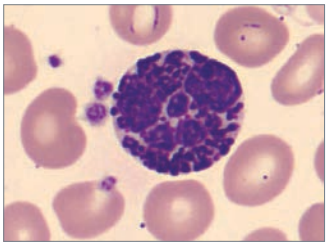
COMMENTS

Giant platelets, 1+ Micro, 1+ Aniso









SUMMARY RESULTS

› The white blood cell differential confirms the analyzer's results

› The peripheral blood smear confirms the thrombocytosis and presence of several large and giant platelets

DIAGNOSIS: THROMBOCYTOSIS

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

Thrombocytosis may have different etiologies as:

- Physiological as exercise, childbirth, etc.
- Reactive to Infections
- Hematological disorders
  - Myeloproliferative neoplasms: Essential thrombocythemia
- Bone marrow regeneration post-hemorrhage
- Recovery from thrombocytopenia or aplasia
- Splenectomy

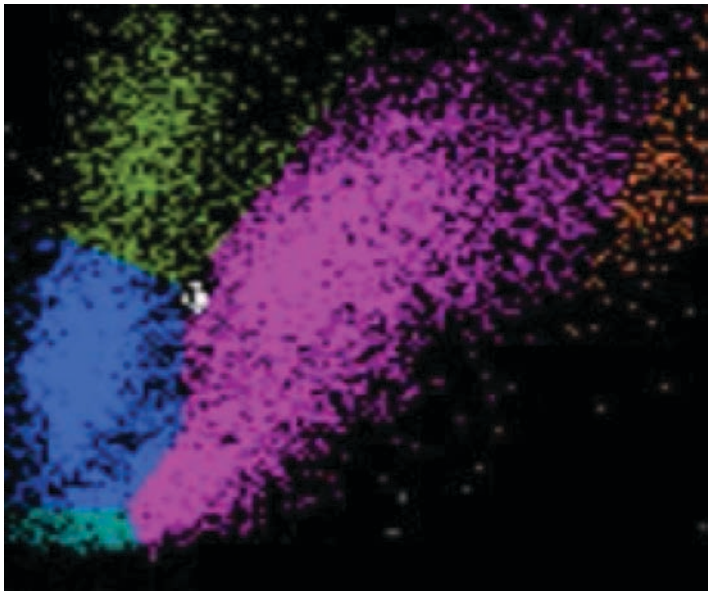
LABORATORY FINDINGS

- Usually the platelets' count > 450 x 10^3/µL
- During an efficient thrombopoiesis large to giant platelets may be observed on the peripheral blood smear

CASE 6 | AGGREGATED PLATELETS

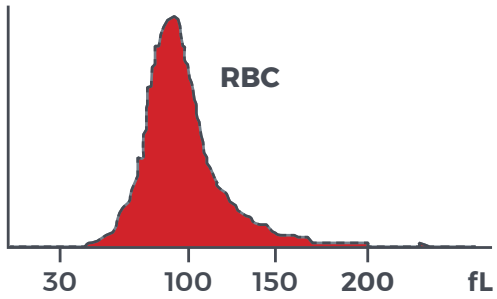
CBC parameters indicate slight macrocytosis. RBC histogram appears normal. The PLT histogram displays cells at approximately 30 fL. Differential scatterplot displays population of cells extending from the Neutrophil region into the Lymphocyte region and into the Cellular Interference region. Due to this severe interference PLT results and differential results are flagged for review.

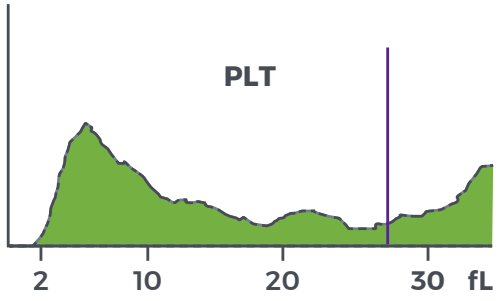
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

FLAGS: Abnormal Diff | Cellular Interference | NE/LY Overlap
LY/MO Overlap | BA Interference | PLT2: Debris



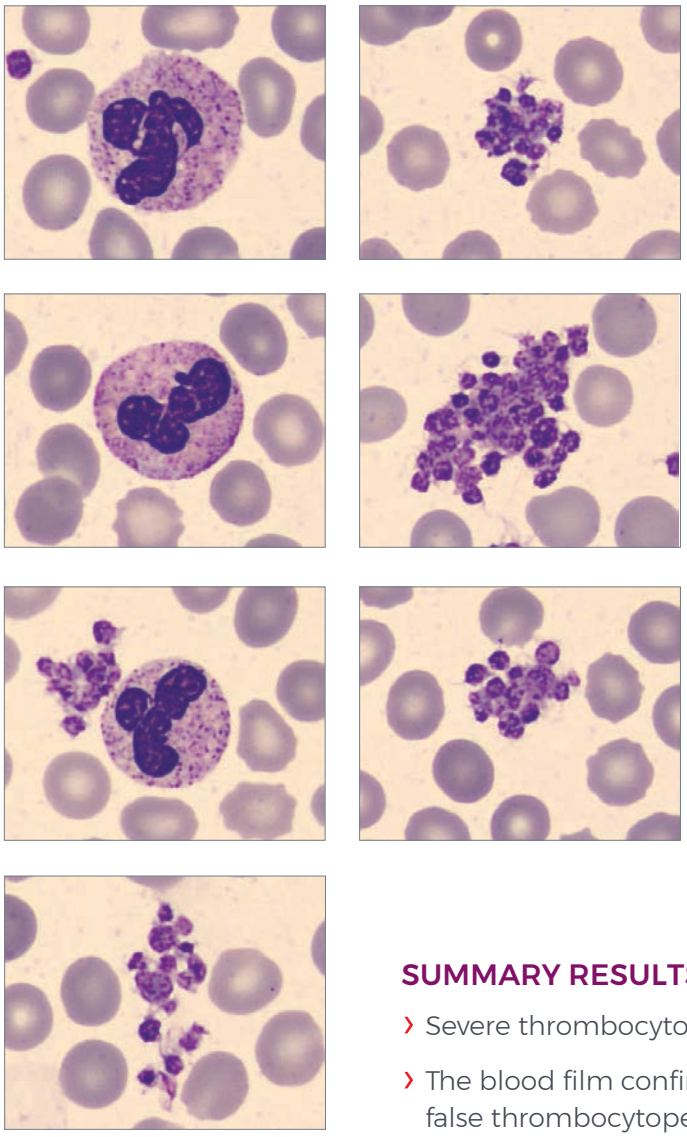


WBC DIFFERENTIAL RESULTS			
WBC	10.02	R	x10³/µL
LY	29.25	R	%
MO	9.30	R	%
NE	58.11	R	%
EO	3.12	R	%
BA	.....		%
LY#	2.93	R	x10³/µL
MO#	0.93	R	x10³/µL
NE#	5.82	R	x10³/µL
EO#	0.31	R	x10³/µL
BA#	.....		x10³/µL

RBC RESULTS			
RBC	3.44	l	x10⁶/µL
HGB	12.15	l	g/dL
HCT	34.0	l	%
MCV	98.9	h	fL
MCH	35.3	H	pg
MCHC	35.7		g/dL
RDW	13.4		%
RDW-SD	47.3	h	fL

PLT RESULTS			
PLT	39.4	RL	x10³/µL
MPV	11.59	Rh	fL

BLOOD SMEAR (CELLAVISION™)



MANUAL DIFFERENTIAL	
NEUTROPHILS	48.0
BAND NEUTROPHILS	
LYMPHOCYTES	30.0
MONOCYTES	10.0
EOSINOPHILS	7.0
BASOPHILS	0.5
METAMYELOCYTES	
MYELOCYTES	0.5
PROMYELOCYTES	
ATYPICAL LYMPHOCYTES	4.0
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	

COMMENTS

Platelet Clumps 3+

SUMMARY RESULTS

- Severe thrombocytopenia due to platelets' aggregation
- The blood film confirms the aggregates and, thus, the false thrombocytopenia

DIAGNOSIS: AGGREGATED PLATELETS

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

The clinical symptoms will be related to the underlying disease.

The false thrombocytopenia can be a consequence of platelets' aggregation caused by a difficult blood collection, by the EDTA anticoagulant or by platelets satellitism.

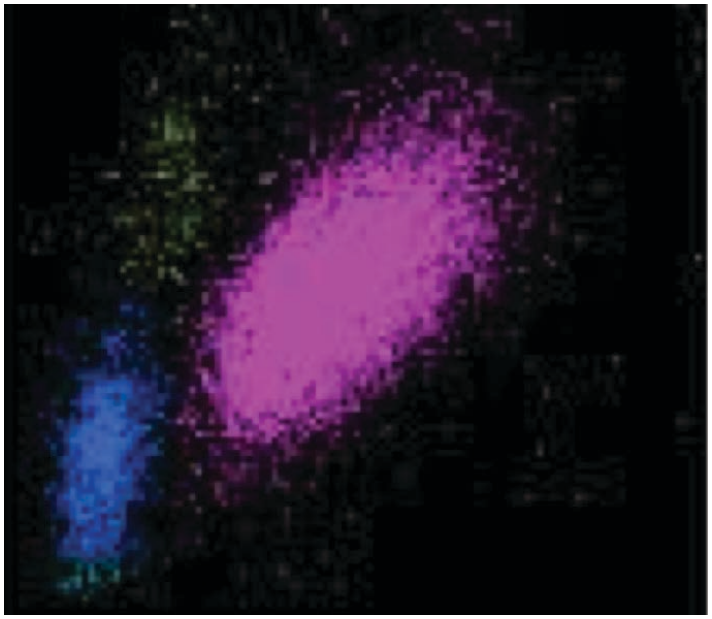
LABORATORY FINDINGS

- Low to very low platelets count
- Abundant platelet aggregates observed on the blood film

CASE 7 | MICROCYTIC HYPOCHROMIC ANEMIA

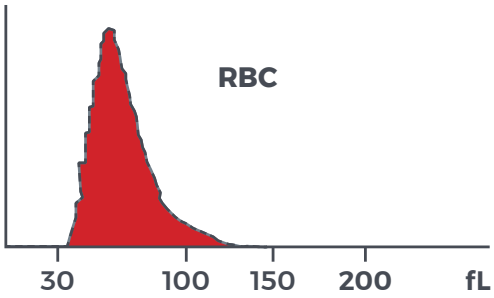
CBC parameters indicate a critical microcytic hypochromic anemia and anisocytosis. WBC histogram shows predominant population in the Neutrophil region with good subpopulations' separation.

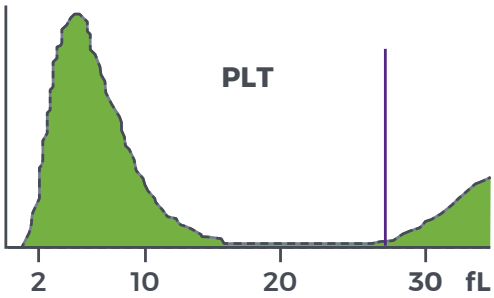
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Suspect Diff



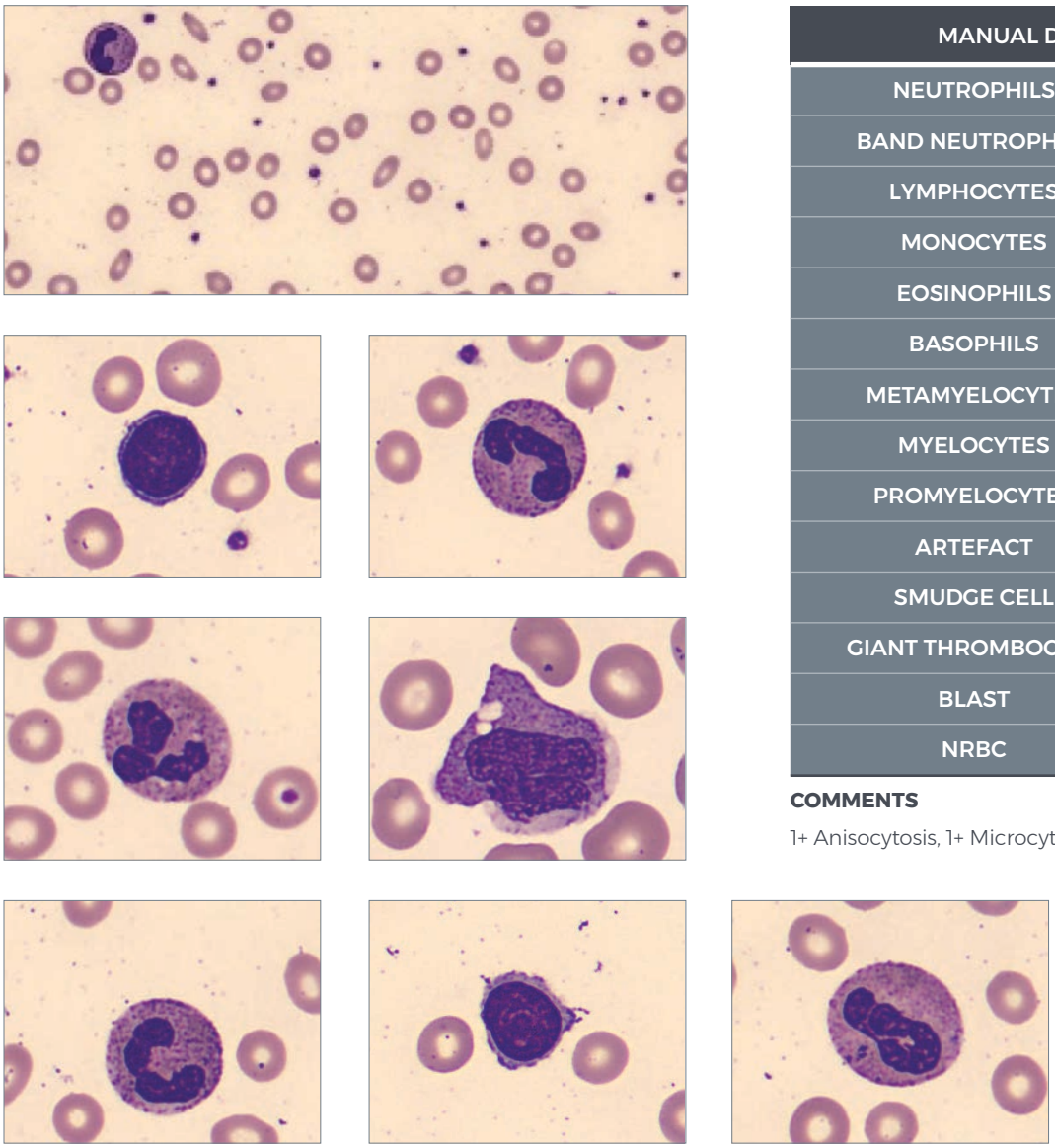


WBC DIFFERENTIAL RESULTS			
WBC	9.19		x10³/µL
LY	10.26	l	%
MO	2.21	l	%
NE	87.16	h	%
EO	0.28	ll	%
BA	0.08	l	%
LY#	0.94	l	x10³/µL
MO#	0.20	l	x10³/µL
NE#	8.01	h	x10³/µL
EO#	0.03		x10³/µL
BA#	0.01		x10³/µL

RBC RESULTS			
RBC	1.95	l	x10⁶/µL
HGB	4.47	L	g/dL
HCT	13.4	L	%
MCV	68.5	l	fL
MCH	22.9	l	pg
MCHC	33.4		g/dL
RDW	17.7	h	%
RDW-SD	35.8	l	fL

PLT RESULTS			
PLT	353.6	h	x10³/µL
MPV	8.00		fL

BLOOD SMEAR (CELLAVISION™)



MANUAL DIFFERENTIAL	
NEUTROPHILS	92.1
BAND NEUTROPHILS	
LYMPHOCYTES	6.2
MONOCYTES	0.8
EOSINOPHILS	
BASOPHILS	0.50
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	0.5

COMMENTS

1+ Anisocytosis, 1+ Microcytosis

SUMMARY RESULTS

Manual differential results indicate a marked neutrophilia and microcytic, hypochromic red blood cells.

DIAGNOSIS: MICROCYTIC HYPOCHROMIC ANEMIA | CLS-142 23 FEMALE RECTAL BLEEDING

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

In this possible anemic syndrome with an underlying iron deficiency anemia the patient may present with

- Dizziness, confusion and loss of concentration, sadness and/or depression
- Tachycardia, short breath and palpitations
- Asthenia, pallor and feeling cold

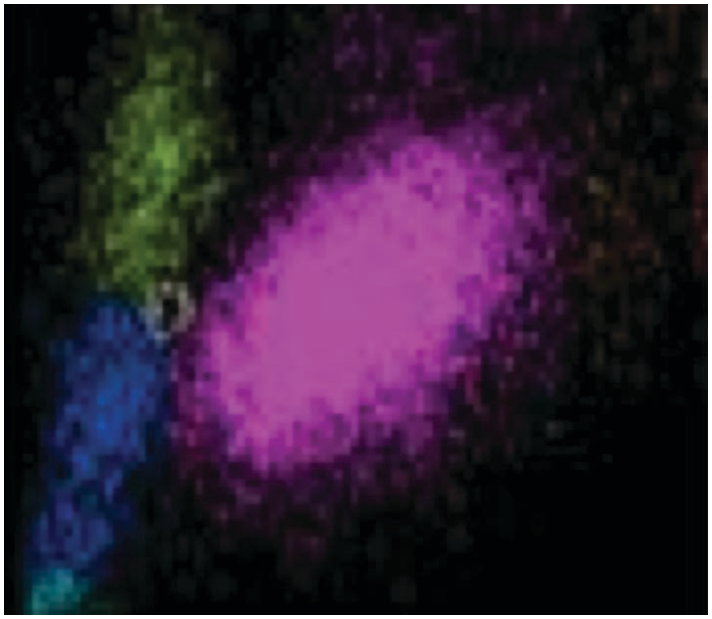
LABORATORY FINDINGS

- Hb < 10 g/dL
- Hypochromic, microcytic anemia
- Anisocytosis

CASE 8 | LEUKOCYTOSIS WITH THROMBOCYTOSIS

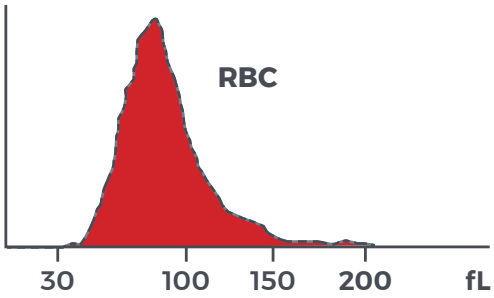
CBC parameters indicate leukocytosis, anisocytosis of RBC without anemia and thrombocytosis. RBC histogram and Platelet histogram appear normal. WBC results show neutrophilia and monocytosis. Differential scatter plot displays population of cells extending from the Lymphocyte region into Cellular Interference region.

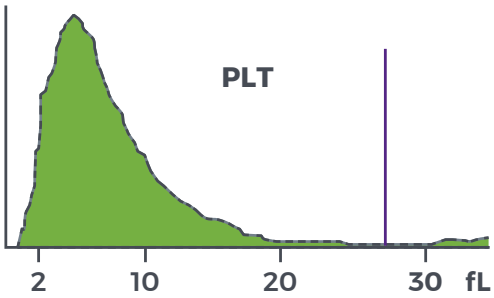
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Suspect Diff



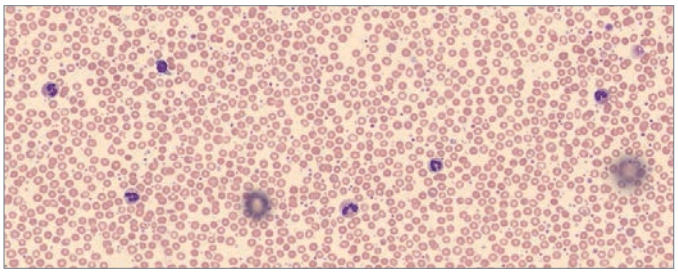


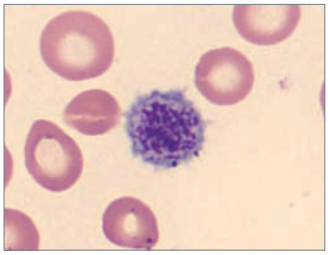
WBC DIFFERENTIAL RESULTS			
WBC	25.41	h	x10³/µL
LY	6.56	l	%
MO	7.42		%
NE	84.32	h	%
EO	1.33		%
BA	0.37		%
LY#	1.67		x10³/µL
MO#	1.89	H	x10³/µL
NE#	21.43	h	x10³/µL
EO#	0.34		x10³/µL
BA#	0.09		x10³/µL

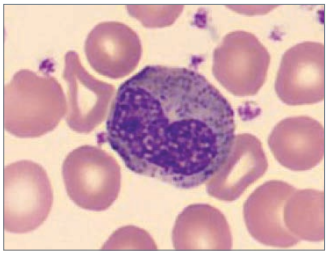
RBC RESULTS			
RBC	4.80		x10⁶/µL
HGB	13.22		g/dL
HCT	41.7		%
MCV	86.9		fL
MCH	27.5		pg
MCHC	31.7	l	g/dL
RDW	19.5	h	%
RDW-SD	60.4	h	fL

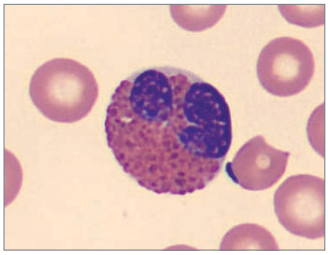
PLT RESULTS			
PLT	1867.5	H	x10³/µL
MPV	7.95		fL

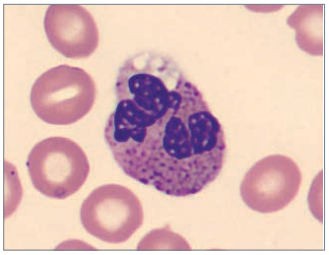
BLOOD SMEAR (CELLAVISION™)







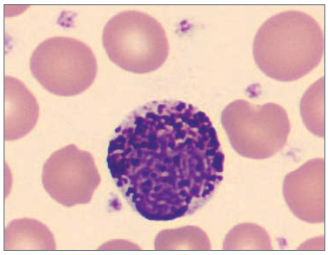


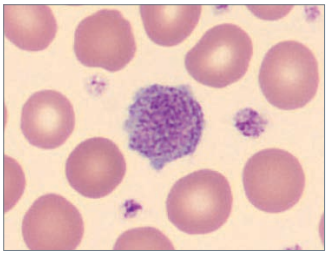


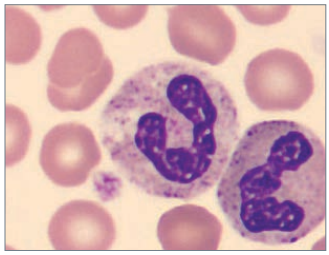
MANUAL DIFFERENTIAL	
NEUTROPHILS	77.68
BAND NEUTROPHILS	3.8
LYMPHOCYTES	1.66
MONOCYTES	10.21
EOSINOPHILS	1.19
BASOPHILS	1.66
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	1.0

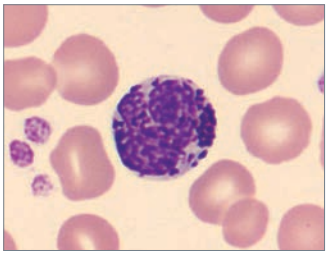
COMMENTS

1+ Anisocytosis, 1+ Microcytosis









SUMMARY RESULTS

- Leukocytosis with neutrophilia and few immature granulocytes
- Marked thrombocytosis with some giant platelets
- The blood film shows one NRBC

DIAGNOSIS: LEUKOCYTOSIS WITH THROMBOCYTOSIS | LHS-046 81 FEMALE COLON CANCER

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

Thrombocytosis may have different etiologies as:

- Physiological as exercise, childbirth, etc.
- Reactive to Infections
- Hematological disorders
  - Myeloproliferative neoplasms: Essential thrombocythemia
- Bone marrow regeneration post-hemorrhage
- Recovery from thrombocytopenia or aplasia
- Splenectomy

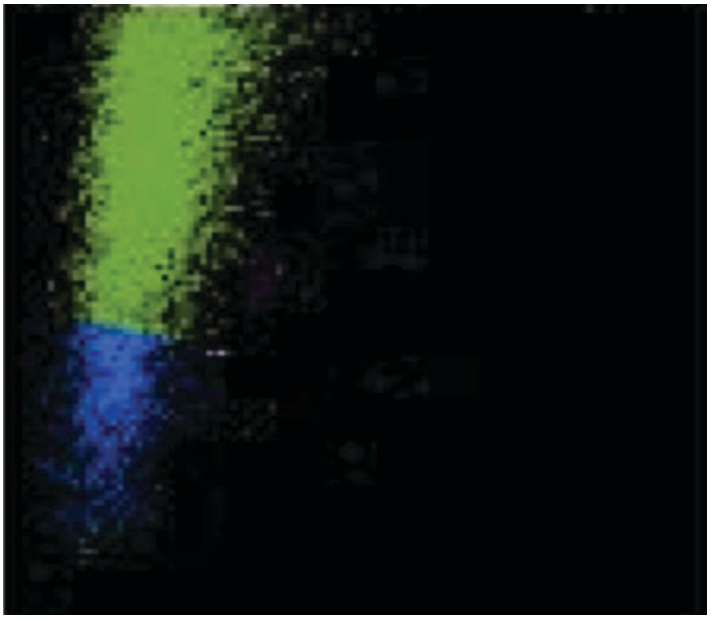
LABORATORY FINDINGS

- Usually the platelets' count > 450 x 10^3/µL
- During an efficient thrombopoiesis large to giant platelets may be observed on the peripheral blood smear

CASE 9 | ACUTE MONOCYTIC LEUKEMIA

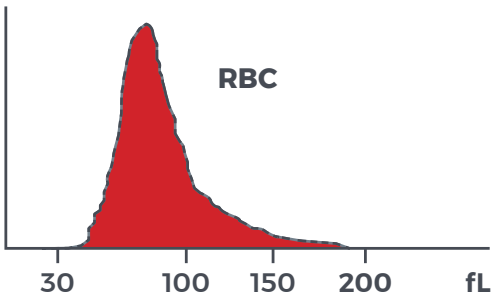
CBC parameters indicate leukocytosis and normocytic anemia with slight anisocytosis. RBC histogram appears normal. Thrombocytopenia with abnormal platelet histogram, which exceeds the limits at PLT2 initiating the PLT 2: Debris message and PLT "R" flag. Differential scatterplot shows single population extending from the Lymphocyte region into the Monocyte region. Presence of large abnormal cells can be suspected as indicated by instrument message. Differential results are flagged for review.

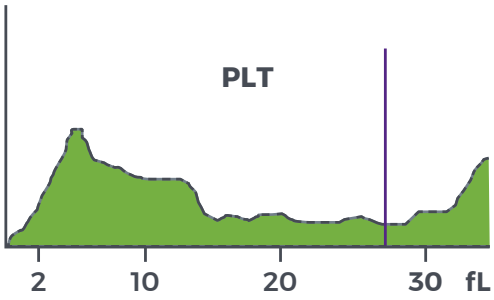
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

FLAGS: Abnormal Diff | Suspect Diff | PLT2 Debris | Large Cells



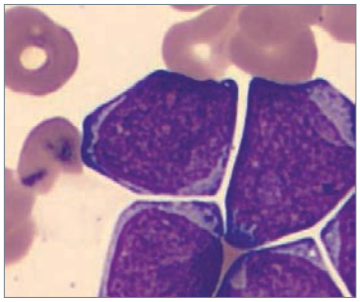
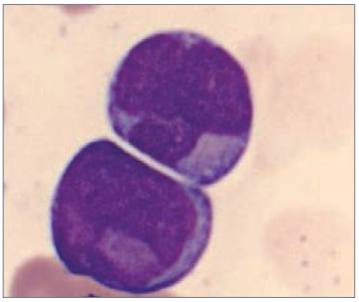
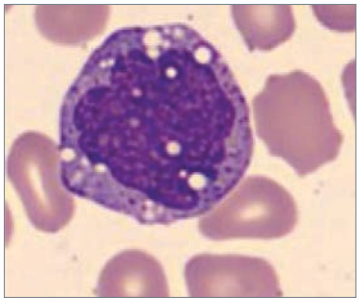
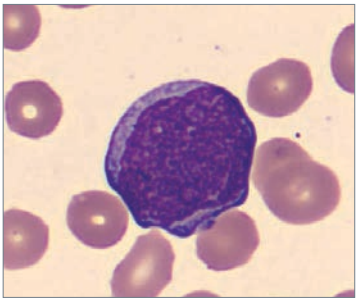


WBC DIFFERENTIAL RESULTS			
WBC	50.09	H	x10³/µL
LY	8.47	Rl	%
MO	91.19	Rh	%
NE	0.30	Rl	%
EO	0.00	Rl	%
BA	0.04	Rl	%
LY#	4.24	Rh	x10³/µL
MO#	45.68	RH	x10³/µL
NE#	0.15	Rl	x10³/µL
EO#	0.00	R	x10³/µL
BA#	0.02	R	x10³/µL

RBC RESULTS			
RBC	2.77	I	x10⁶/µL
HGB	8.68	I	g/dL
HCT	25.8	I	%
MCV	93.0		fL
MCH	31.3		pg
MCHC	33.6		g/dL
RDW	16.1		%
RDW-SD	47.9	h	fL

PLT RESULTS			
PLT	16.1	RL	x10³/µL
MPV	12.40	Rh	fL

BLOOD SMEAR (CELLAVISION™)

MANUAL DIFFERENTIAL		
NEUTROPHILS		0.255
BAND NEUTROPHILS		
LYMPHOCYTES	20/24	7.4
MONOCYTES	7/87	4.6
EOSINOPHILS		0
BASOPHILS	0/1	0
METAMYELOCYTES		0
MYELOCYTES	0/1	0
PROMYELOCYTES	0/5	0
ARTEFACT	5/4	
SMUDGE CELL	21/19	
GIANT THROMBOCYTE		
BLAST	96/84	87.4
NRBC	0/1	0.5

SUMMARY RESULTS

› The manual differential confirms the critical neutropenia and very high blasts percentage

DIAGNOSIS: ACUTE MONOCYTIC LEUKEMIA (AML) | 71 MALE LEUKEMIA (ACUTE MYELOID)

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

- AML is the most common form of acute leukemia in adults
- Genetic damage results in (i) an increased rate of proliferation, (ii) reduced apoptosis and (iii) a block in cellular differentiation
- Bone marrow failure caused by the accumulation of malignant cells within marrow
- Frequent infections
- Acute Monocytic Leukemia comprises 5–8% of AML
- Typical and microgranular APL are frequently associated with disseminated intravascular coagulation (DIC)

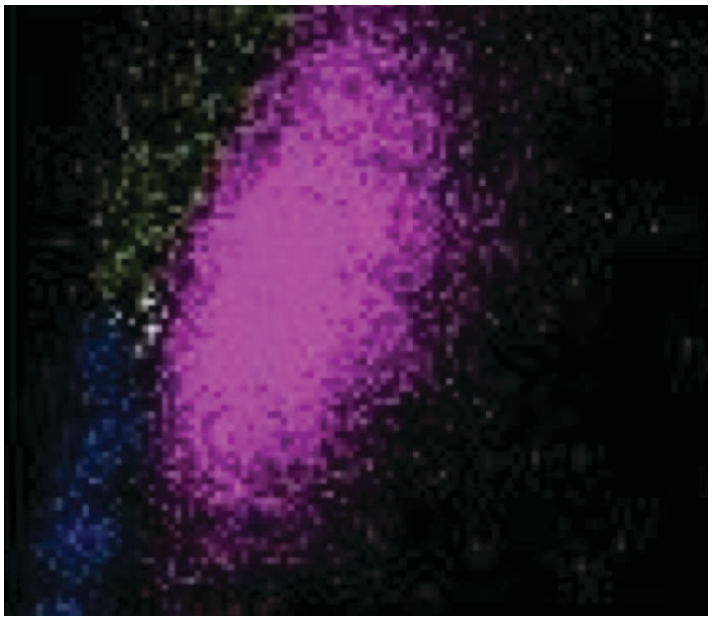
LABORATORY FINDINGS

- >20% blasts in the bone marrow
- Normocytic normochromic anemia
- Thrombocytopenia (80% of cases)
- Due to a very wide variability in acute myeloid leukemia's WBC count, no specific cutoff is available

CASE 10 | LEUKOCYTOSIS WITH IMMATURE GRANULOCYTE

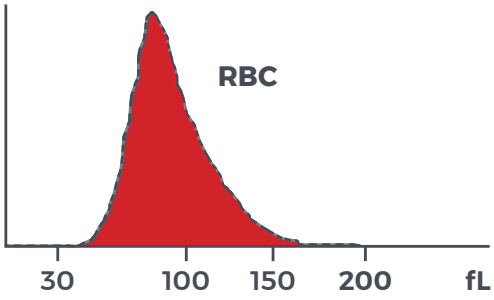
CBC parameters indicate leukocytosis and normocytic anemia with anisocytosis. Platelets histogram appears normal. Differential scatterplot displays abnormal pattern with predominant population of neutrophils, extending into the Large cells' region, suggesting presence of abnormal immature cells. WBC differential results are flagged for review due to presence of multiple flags.

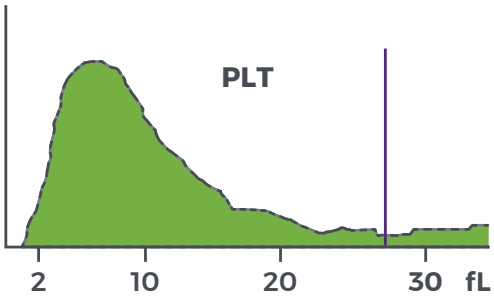
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Abnormal Diff | Suspect Diff | Large Cells



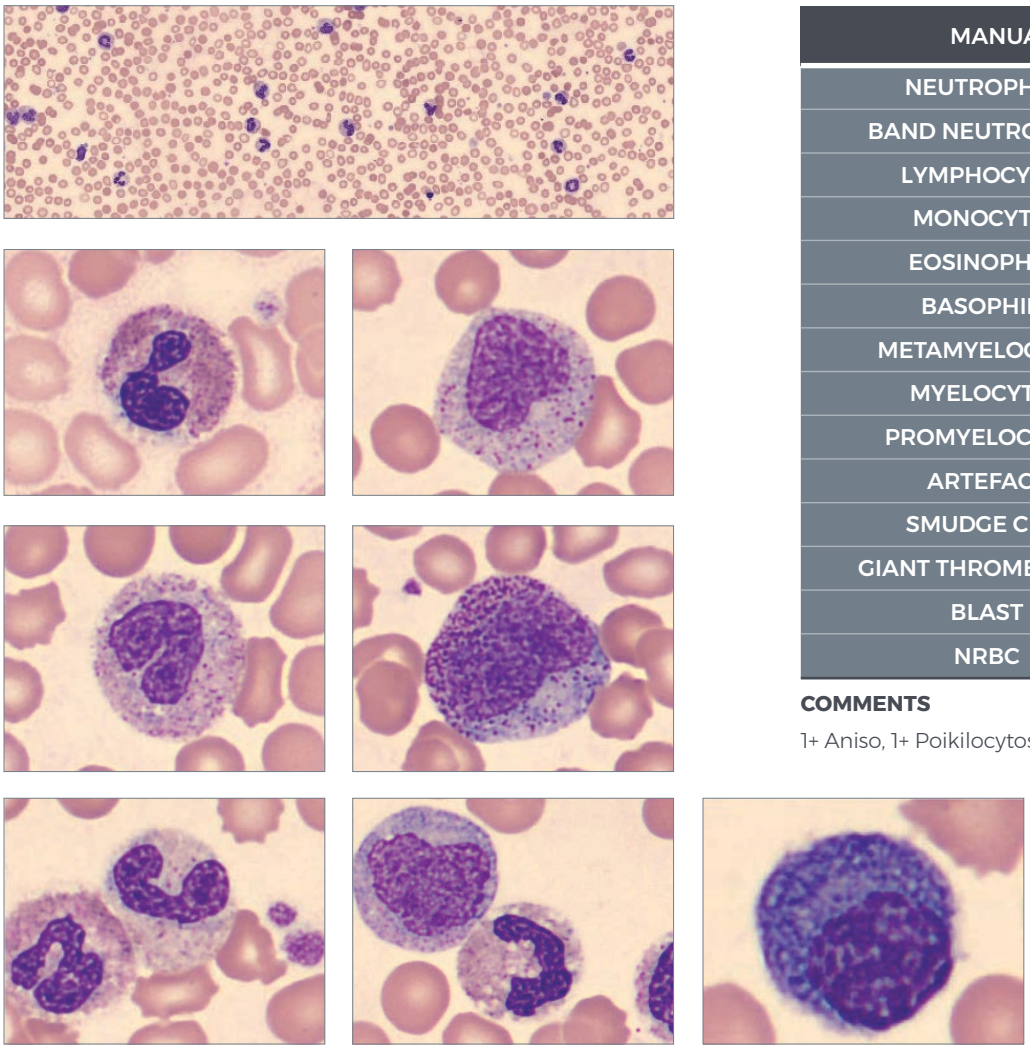


WBC DIFFERENTIAL RESULTS			
WBC	77.48	hH	x10³/µL
LY	2.82	Rl	%
MO	3.28	Rl	%
NE	93.34	Rh	%
EO	0.27	Rl	%
BA	0.29	R	%
LY#	2.18	R	x10³/µL
MO#	2.54	RH	x10³/µL
NE#	72.32	RH	x10³/µL
EO#	0.21	R	x10³/µL
BA#	0.22	Rh	x10³/µL

RBC RESULTS			
RBC	2.94	l	x10⁶/µL
HGB	8.62	l	g/dL
HCT	27.2	l	%
MCV	92.5		fL
MCH	29.3		pg
MCHC	31.7	l	g/dL
RDW	17.0	h	%
RDW-SD	56.4	h	fL

PLT RESULTS			
PLT	194.6	H	x10³/µL
MPV	10.39		fL

BLOOD SMEAR (CELLAVISION™)



MANUAL DIFFERENTIAL	
NEUTROPHILS	38.4
BAND NEUTROPHILS	50.0
LYMPHOCYTES	2.0
MONOCYTES	2.5
EOSINOPHILS	0.3
BASOPHILS	0.3
METAMYELOCYTES	2.2
MYELOCYTES	2.7
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	3.0

COMMENTS

1+ Aniso, 1+ Poikilocytosis

SUMMARY RESULTS

› The blood film shows 50% of band Neutrophils some of which with mild toxic granulations

› Few metamyelocytes and myelocytes and few NRBCs confirm the suspicion of a leukemoid reaction following the pancreatitis

DIAGNOSIS: LEUKOCYTOSIS WITH IMMATURE GRANULOCYTE | IUH-175 60 MALE PANCREATITIS

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

- Persistent neutrophilic leukocytosis above 50,000 cells/µL when the cause is other than leukemia defines a leukemoid reaction (LR).
- The diagnostic work-up consists of the exclusion of chronic myelogenous leukemia (CML) and chronic neutrophilic leukemia (CNL) and the detection of an underlying cause.
- The major causes of leukemoid reactions are severe infections, intoxications, malignancies, severe hemorrhage, or acute hemolysis.

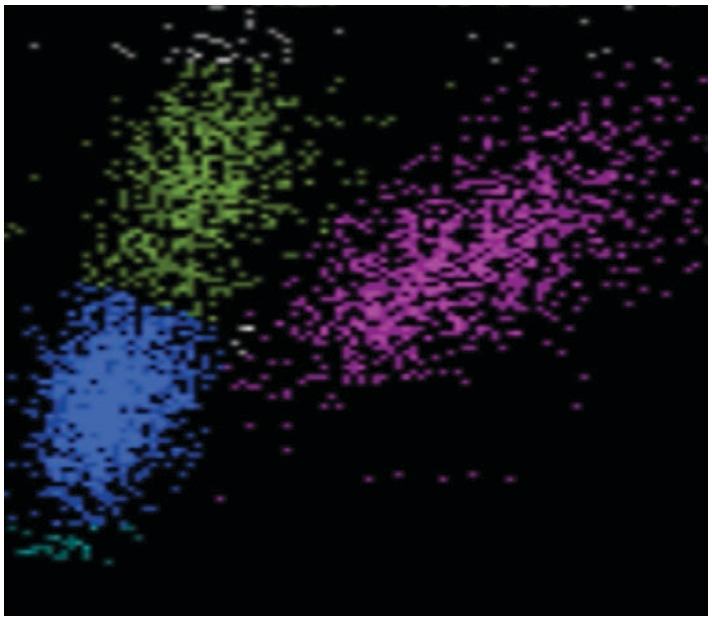
LABORATORY FINDINGS

- In LR, leukocyte counts are, by definition, greater than 50,000 cells/µL and consist mostly of mature neutrophils.
- The peripheral smear may, in addition, demonstrate toxic granulation, Doëhle bodies, and cytoplasmic vacuoles in the neutrophils of patients with an LR attributed to an infection.
- An expert's review of the peripheral smear is necessary to exclude a myeloproliferative syndrome.

CASE 11 | PLASMACELLULAR DYSCRASIA

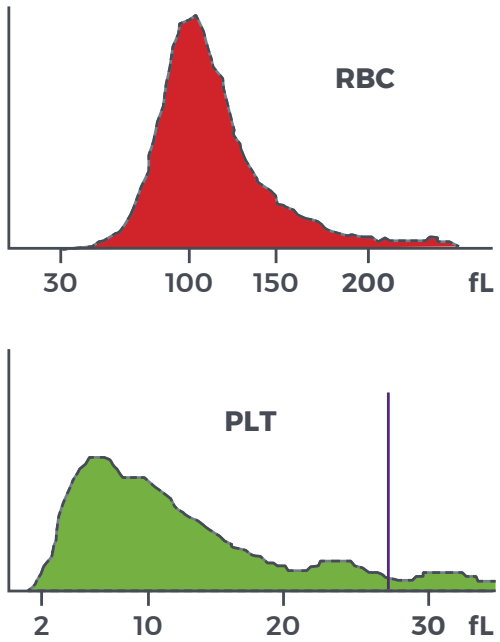
CBC parameters indicate leukopenia, thrombocytopenia, macrocytosis and anisocytosis without anemia. The RBC histogram appears normal although macrocytic, the mode of the population above 100 fL. WBC results show neutropenia. Differential scatterplot displays small population of cells extending from the Lymphocyte region into the Cellular interference region and another extending from the Monocyte region into the Large cells' region.

DxH 500 SERIES SCATTER PLOT



WBC DIFFERENTIAL RESULTS			
WBC	3.05	l	x10³/µL
LY	44.48	h	%
MO	21.72	h	%
NE	33.17	l	%
EO	0.46	l	%
BA	0.17	l	%
LY#	1.36		x10³/µL
MO#	0.66		x10³/µL
NE#	1.01	l	x10³/µL
EO#	0.01		x10³/µL
BA#	0.01		x10³/µL

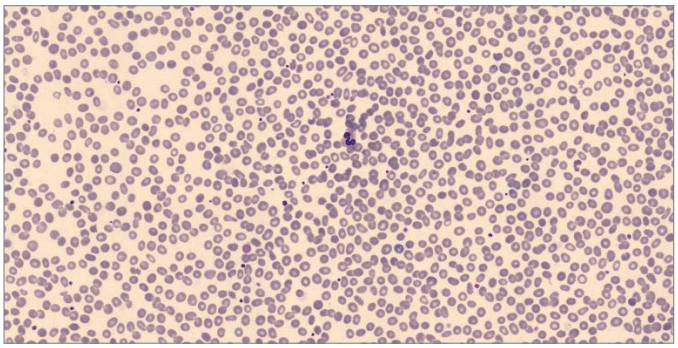
FLAGS AND MESSAGES

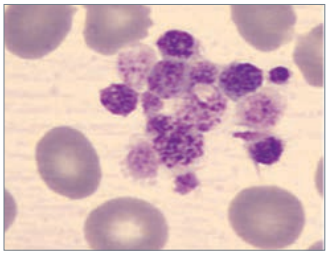


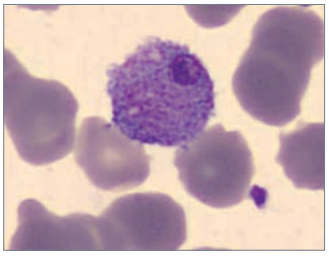
RBC RESULTS			
RBC	3.90	l	x10⁶/µL
HGB	14.14		g/dL
HCT	44.3		%
MCV	113.7	H	fL
MCH	36.3		pg
MCHC	31.9		g/dL
RDW	16.5	h	%
RDW-SD	72.1	h	fL

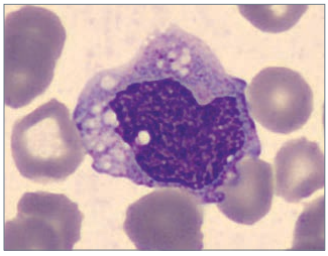
PLT RESULTS			
PLT	87.6	l	x10³/µL
MPV	11.38		fL

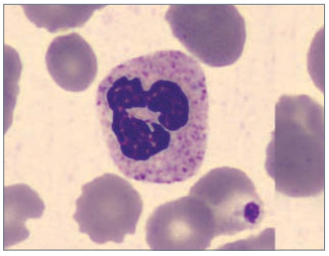
BLOOD SMEAR (CELLAVISION™)

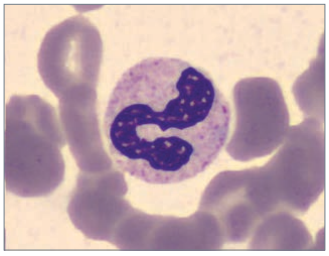


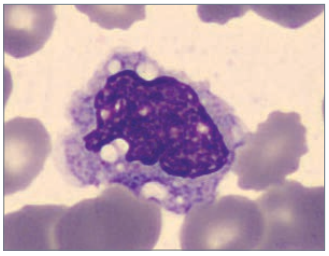


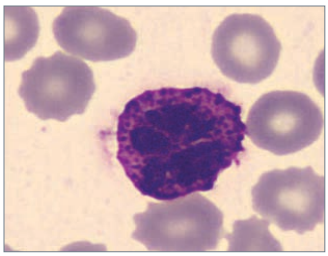


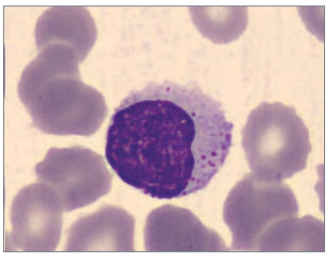


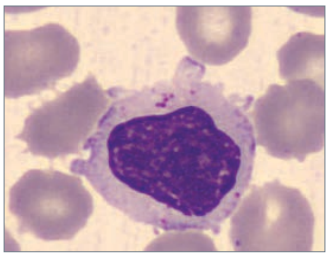


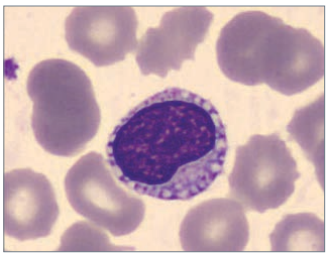












MANUAL DIFFERENTIAL	
NEUTROPHILS	30.5
BAND NEUTROPHILS	
LYMPHOCYTES	46.5
MONOCYTES	21.5
EOSINOPHILS	1.0
BASOPHILS	0.5
METAMYELOCYTES	
MYELOCYTES	
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	

COMMENTS

RBC: macrocytosis | PLT: very rare PLT clumps

SUMMARY RESULTS

› Marked macrocytic normochromic anemia with thrombocytopenia
› WBC differential provided by the hematology analyzer is very similar to the manual differential

DIAGNOSIS: PLASMACELLULAR DYSCRASIA

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

- Bone pain (especially backache) resulting from vertebral collapse and pathological fractures.
- Features of anemia, e.g. lethargy, weakness, dyspnea, pallor, tachycardia.
- Recurrent infections related to deficient antibody production, abnormal cell mediated immunity and neutropenia.

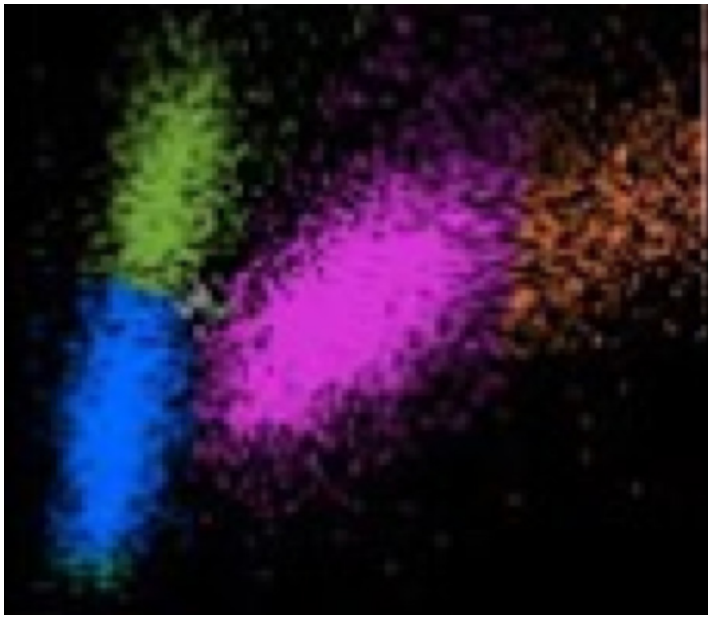
LABORATORY FINDINGS

- Presence of paraprotein
- Elevated serum immunoglobulin-free light chains
- There is usually a normochromic, normocytic or macrocytic anemia
- High erythrocyte sedimentation rate

CASE 12 | EOSINOPHILIA

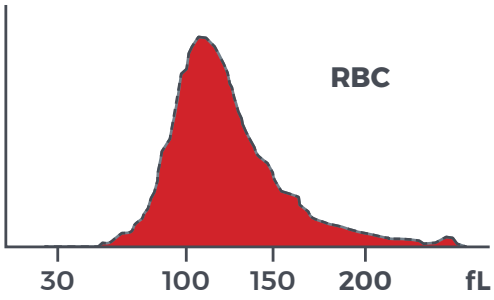
CBC parameters indicate leukocytosis, macrocytic anemia with anisocytosis. Platelet histogram appears normal although platelet count is slightly elevated. WBC results show monocytosis and eosinophilia. Differential scatterplot displays population of cells extending from the Lymphocyte region into the Cellular Interference region.

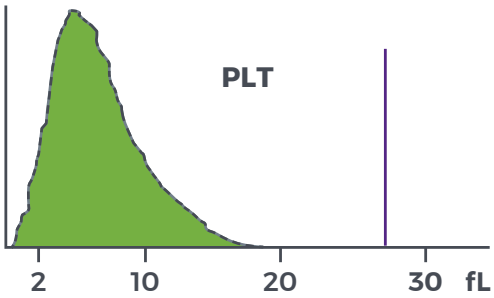
DxH 500 SERIES SCATTER PLOT



FLAGS AND MESSAGES

Flags: Suspect Diff



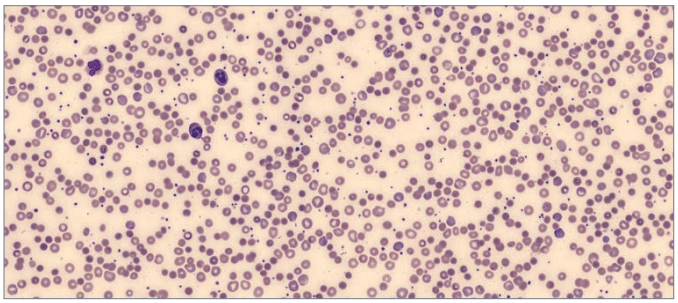


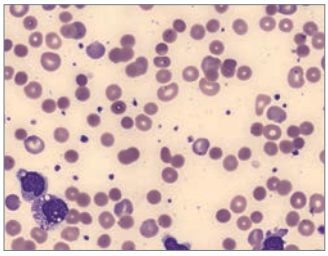
WBC DIFFERENTIAL RESULTS			
WBC	12.01	h	x10³/µL
LY	22.17		%
MO	14.37	h	%
NE	54.44		%
EO	8.73	h	%
BA	0.28		%
LY#	2.66		x10³/µL
MO#	1.73	H	x10³/µL
NE#	6.54		x10³/µL
EO#	1.05	H	x10³/µL
BA#	0.03		x10³/µL

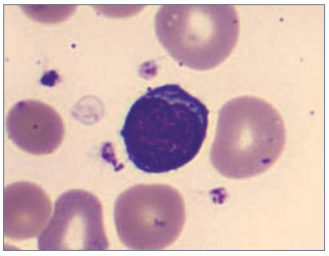
RBC RESULTS			
RBC	1.91	l	x10⁶/µL
HGB	7.46	L	g/dL
HCT	22.5	l	%
MCV	117.8	H	fL
MCH	39.1	H	pg
MCHC	33.2		g/dL
RDW	13.9		%
RDW-SD	63.9	h	fL

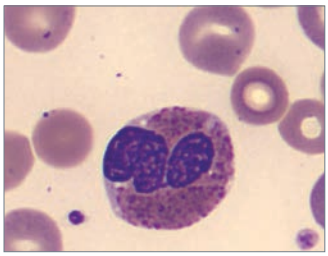
PLT RESULTS			
PLT	373.6	h	x10³/µL
MPV	7.42		fL

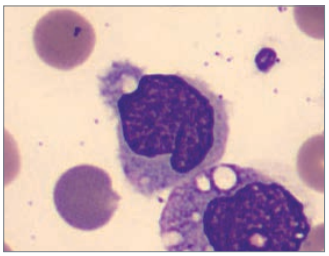
BLOOD SMEAR (CELLAVISION™)

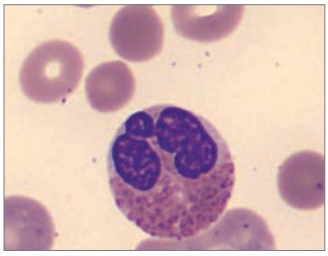


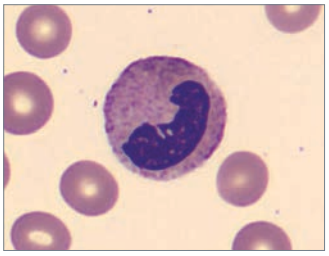


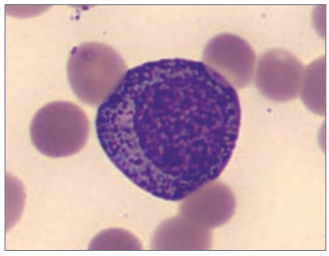


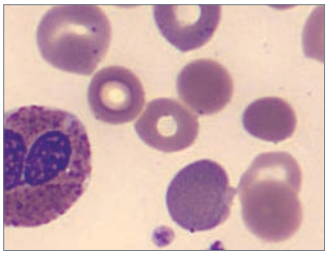












MANUAL DIFFERENTIAL	
NEUTROPHILS	53.1
BAND NEUTROPHILS	0.3
LYMPHOCYTES	20.3
MONOCYTES	11.0
EOSINOPHILS	9.3
BASOPHILS	1.5
METAMYELOCYTES	1.5
MYELOCYTES	1.5
PROMYELOCYTES	
ARTEFACT	
SMUDGE CELL	
GIANT THROMBOCYTE	
BLAST	
NRBC	3.0

COMMENTS

2+ Anisocytosis, 1+ Microcytosis, 1+ Macrocytosis

SUMMARY RESULTS

- The manual differential confirms the eosinophilia and the macrocytic anemia
- The presence of very abundant spherocytes explains the hyperchromia (MCH = 39.1 pg)

DIAGNOSIS: EOSINOPHILIA | CLS-051 65 MALE ANEMIA

DESCRIPTION OF THE DISEASE

CLINICAL FEATURES

Eosinophilic leukocytosis is most frequently caused by allergic diseases, parasites, skin diseases or drugs.

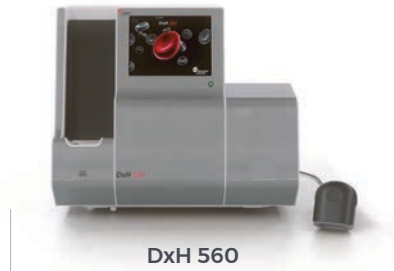
If the eosinophil count is elevated (>1.5 x 103/µL) for over 6 months and associated with tissue damage, then the hypereosinophilic syndrome is diagnosed.

LABORATORY FINDINGS

Eosinophils count >0.4 x 10^3/µL

DxH 500 SERIES OFFERING

OUR 500 SERIES FOR LOW VOLUME HEMATOLOGY ANALYZERS INCLUDE:



INSTRUMENT	DxH 500	DxH 520	DxH 560
Mode of Operation	Open tube sampling	Closed tube and Open tube sampling	Autoloader with 50 tube continuous loading capacity. Open tube sampling.
Throughput	Up to 60 samples/hour	Up to 55 samples per hour in closed tube Up to 60 samples per hour in open tube	Up to 55 samples per hour in closed tube Up to 60 samples per hour in open tube
Sample Volume Aspiration	12µL 20 µL in pre-dilute mode	17µL 20 µL in pre-dilute mode	17µL
Menu/Test Parameters	WBC, RBC, HGB, HCT, MCV, MCH, MCHC, RDW-SD, RDW-CV, PLT, MPV, LY%, LY#, MO%, MO#, NE%, NE#, EO%, EO#, BA%, BA#		
RUO Parameters*	IMM%, IMM#, LHD, MAF, PCT, PDW		
User Interface	Touch screen; Handheld barcode scanner included		
Power Requirements	100–240 VAC 50–60 Hz/Single phase with ground		
Power Consumption	Less than 120W		
Operational Ambient Temperature	18–32˚C (64.4–89.6˚F)		
Humidity	80% relative humidity (non-condensing) at 32˚C (89.6˚F)		
Altitude	Up to 3,000 meters (9,843 feet)		
External Storage	Supports USB 2.0 (five ports)		
LIS	Supports serial (RS-232) and Ethernet communication		
Printer	Optional USB printer, laser or ink jet		
Languages	Czech, English, French, German, Iberian Portuguese, Italian, Japanese, Romanian, Spanish, Russian		
Width	270 mm (10.6 in)	270 mm (10.6 in)	500 mm (19.7 in.)
Height	406 mm (16.0 in)	406 mm (16.0 in)	440 mm (17.3 in.)
Depth	430 mm (16.9 in)	430 mm (16.9 in)	460 mm (18.1 in.)
Weight	11.4 kg (25.1 lbs)	11.4 kg (25.1 lbs)	22 kg (48.5 lbs.)

*RUO parameters are not available for use in the United States.

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