sysmex

XN-Series

Automated Hematology Analyzer

Clinical Case Report Vol.3 (BF mode)

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XN

Prefatory note

Body fluids such as ascites, pleural, synovial and cerebrospinal fluids are sampled by aspiration and tested when they show abnormal accumulation. Such tests provide important information for differential diagnosis by the physicians. The white blood cell count and classification of cells in body fluids and puncture fluids can be used by the physician for differentiating the pathophysiology of inflammation and tumors, and for making definitive diagnosis, as they indicate the causes of the pathological retention. These measurements were conventionally made visually on microscopy. In recent years, however, body fluids are often tested as emergency tests, and automated hematology analyzers are increasingly used. With the advancement of the technology, such analyzers are now capable of automated white blood cell and differential white blood cell counting of not only peripheral blood but body fluids also, and their performance is being continuously upgraded.

Sysmex Corporation has launched the newly developed XN-Series Automated Hematology Analyzer. The new analyzers have a BF mode which measure body fluids as a new function. Their white blood cell differential channel (WDF channel) can determine the white blood cell counts, differentiate their fraction, and detect abnormal cells through its optimized reagent reaction, signal processing, and analysis algorithms. The specimens used in body fluid analysis and their characteristics are very diverse. The cells present and their morphology differ, depending on the type of specimen, and the disease and its pathophysiology. Interpretation of body fluid analysis data requires care; as such diversity may impact the analysis results in various ways. On the other hand, body fluid testing is done frequently as a part of general testing and emergency testing. Therefore, a laboratory technologist or nurse who is not quite familiar with microscopic morphological testing or the use of automated analyzers might operate such analyzers. This booklet was prepared to help the users to better understand the functions of the XN-series analyzers and interpret body fluid analysis data. In its first part, it explains the information on each analysis parameter displayed and its significance. In the following section on case studies, the white blood cell count, white blood cell differentials, and scattergrams of body fluid specimens generally tested in typical diseases are provided along with other test findings and micrographs of the fluid smears which are necessary for understanding the pathophysiology, and for diagnosis by the physician. Comparison of the data generated by the analyzer with visual differential counts and cell morphology findings (micrographs) helps in the interpretation of cell distribution abnormalities seen in the scattergrams. The interpretation of cell morphology and laboratory findings and the basis of the differential diagnosis are given in the description of each case. Additional information includes the points to be noted when there is a cell distribution abnormality in the scattergram, or when data and scattergrams generated by the analyzer largely differ from the microscopic information. The effects of analyzer performance and of specimen handling (specimen storage for example) are also touched upon, where required for proper interpretation of the data.

For early detection of the pathophysiology and abnormal samples, and for adoption of appropriate measures, I believe it is important for the laboratory technologist or nurse to be able to interpret the displayed data, i.e., the white blood cell count, the differentials and abnormalities in the scattergram patterns, in body fluid analysis by an XN analyzer. The cases reported here are typical examples of only a limited number of diseases. Even with the same disease, there are various pathophysiological conditions, including the disease stage and modifications by treatment. Besides these, there may be various effects on the analysis results depending on how the specimen is stored after sampling. Therefore, the case study data reported here are intended for reference use only, and I hope that each institution will deepen its understanding of the functions of this analyzer and the parameters measured by it, through studying many cases and conditions. It would be my pleasure if this booklet helps the users in achieving this purpose and contributes to their work of testing, as a reference source.

April 2012

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Measurement principles and analysis parameters

Body fluid mode

Analysis channel	Principles	Analysis parameter	Meanings
WDF Dilution 1:20	Flow cytometry method using semiconductor laser	WBC-BF	White blood cell (leukocyte) count
		MN#	Mononuclear cell count
		MN%	Mononuclear cell percent
		PMN#	Polymorphonuclear cell count
		PMN%	Polymorphonuclear cell percent
		TC-BF#	Total nucleated cell count
RBC Dilution 1:498	Sheath flow DC detection method	RBC-BF	Red blood cell (erythrocyte) count

(The body fluid analysis can only be performed if the analyzer offers the body fluid mode.)

Research parameters

Body fluid mode

Analysis channel	Research Parameter	Meanings
WDF	HF-BF#	The count in the area with a stronger fluorescence signal than the WBC-BF area of the WDF scattergram.
	HF-BF%	HF-BF count divided by WBC-BF and expressed as a percentage.
	NE-BF#	The count in the NEUT area of the WDF scattergram.
	NE-BF%	NE-BF count divided by WBC-BF and expressed as a percentage.
	LY-BF#	The count in the LYMPH area of the WDF scattergram.
	LY-BF%	LY-BF count divided by WBC-BF and expressed as a percentage.
	MO-BF#	The count in the MONO area of the WDF scattergram.
	MO-BF%	MO-BF count divided by WBC-BF and expressed as a percentage.
	EO-BF#	The count appearing in the EO area of the WDF scattergram.
	EO-BF%	The count in the EO area of the WDF scattergram.
RBC	RBC-BF2	RBC in the body fluid mode with a minimum of 100/μL displayed.

(The body fluid analysis can only be performed if the analyzer offers the body fluid mode.)

IP message parameters

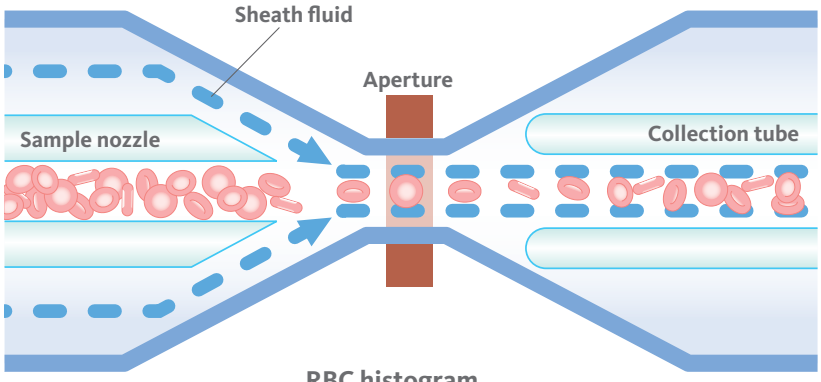
	Message	Meaning	Analysis channel	Judgment method/equation
WBC	***Abnormal***			
	WBC Abn Scattergram	Abnormal WBC scattergram	WDF	Based on clustering in WNR and WDF scattergrams. For body fluid analysis, based on clustering in the WDF scattergram and the HF-BF value.

Measurement principle of sheath flow DC detection

RBC channel

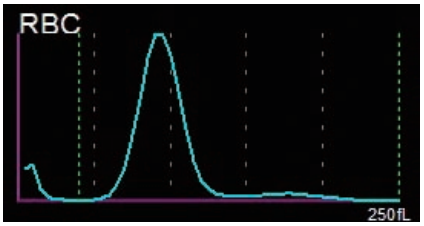
Reagent CELLPACK DCL/DST

The RBC channel counts red blood cells and platelets using the sheath flow DC (direct current) detection method. A diluted sample is ejected from the nozzle tip and blood cells pass through the specified path at the center of the aperture enclosed in the sheath fluid. As each blood cell passes through the center of the aperture, blood cell volume information is accurately reflected in the pulse. The cell signals are sensitively captured because of innovations in the unique digital waveform processing technology.
The number of particles counted in the body fluid mode is about three times more than in the whole blood mode.



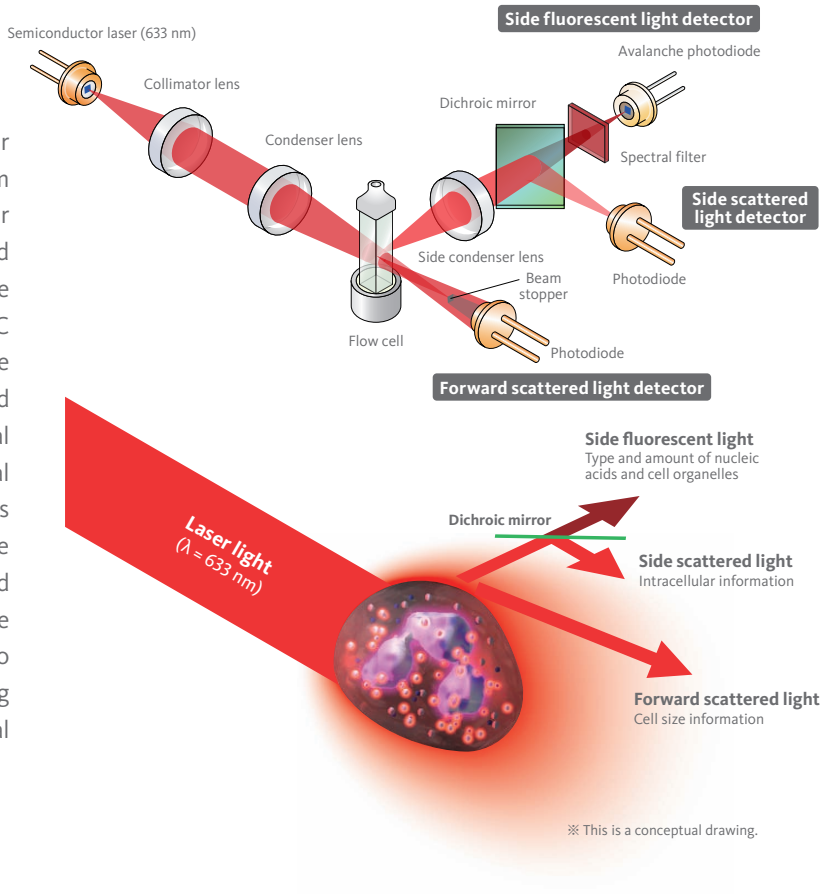
※ This is a conceptual drawing.

RBC histogram



Measurement principle of flow cytometry with a semiconductor laser

The flow cytometry using a semiconductor laser counts and classifies cells by irradiating them with a 633 nm laser beam and analyzing their forward scattered light (FSC), side scattered light (SSC) and side fluorescent light (SFL). The intensity of the two types of scattered light (FSC and SSC) reflects cell surface structure, particle shape, nucleus form, refractive index and reflectivity of the cells. In general, the FSC signal is stronger for larger cells, and the SSC signal becomes stronger as the intracellular structures become more complex. The intensity of the side fluorescent light mainly reflects the type and amount of nucleic acids and cell organelles. The white blood cells are counted and classified into mononuclear and polymorphonuclear cells using these three signals, fully exploiting digital technologies and algorithms.



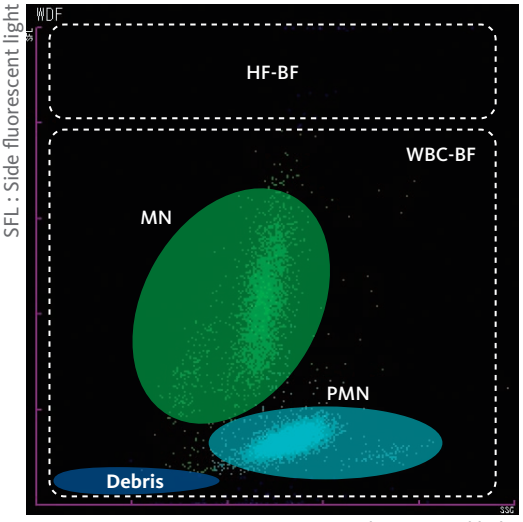
WDF channel

Reagent Lysercell WDF, Fluorocell WDF

In the WDF channel, the white blood cells are counted and classified into mononuclear (MN) cells and polymorphonuclear (PMN) cells. Surfactants in Lysercell WDF hemolyze red blood cells and penetrate the cell membrane of white blood cells. After that, the fluorescent dye in the Fluorocell WDF enters the cells and stains nucleic acids and cell organelles. Cells other than blood cells (such as mesothelial cells and abnormal cells like tumor cells of mesothelial and epithelial origin) are similarly stained. Analysis of differences in the intensity of scattered light and fluorescent light from individual cells using Sysmex proprietary algorithms enables white blood cell counting, white blood cell classification, and detection of abnormal cells.

The number of particles counted in this channel in the body fluid mode is about 10 times higher than in the whole blood mode.

WDF scattergram



SSC : Side scattered light

An example of a body fluid analysis (BF mode)

Analysis results (main screen)

WBC

Item	Data	Unit
WBC-BF	0,945	10^9/L

RBC

Item	Data	Unit
RBC-BF	0,206	10^12/L

WBC Differential

Item	Data	Unit
MN#	0,278	10^9/L
PMN#	0,667	10^9/L
MN%	29,4	%
PMN%	70,6	%
TC-BF#	0,974	10^9/L

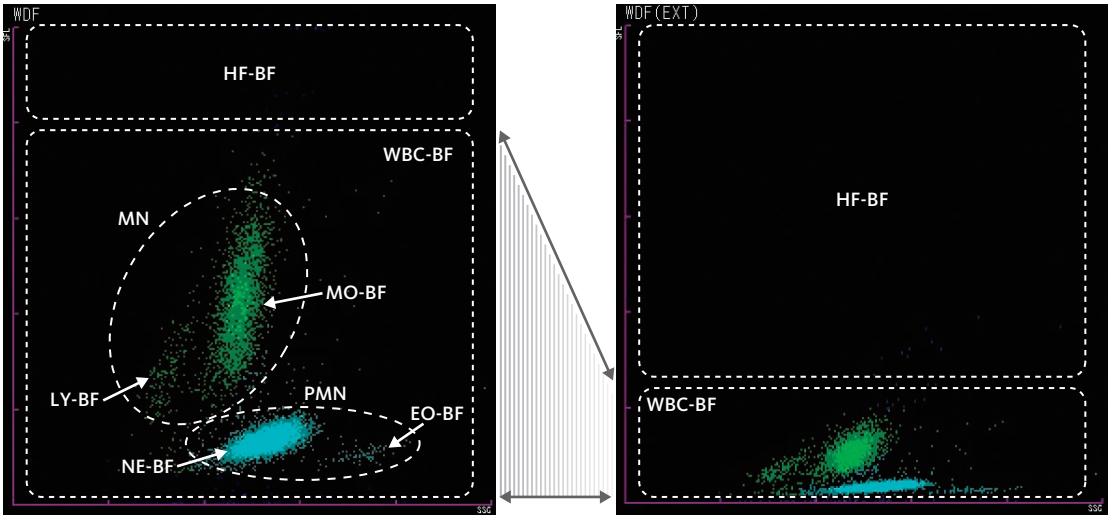
WBC Flag(s)

(Lab. Use Only screen)

Item	Data	Unit
HF-BF#	0,002	10^9/L
HF-BF%	0,0	/100WBC
NE-BF#	0,659	10^9/L
NE-BF%	69,8	%
LY-BF#	0,019	10^9/L
LY-BF%	2,0	%
MO-BF#	0,259	10^9/L
MO-BF%	27,4	%
EO-BF#	0,008	10^9/L
EO-BF%	0,8	%
RBC-BF2	0,2061	10^12/L

Diagnostic parameters: The numerical data for a total of 7 diagnostic parameters are displayed on the main screen.
Research parameters: Research parameter results are indicated with a gray background on the Lab Use Only screen.
Flag(s): WBC IP Messages can be displayed accordingly.

Scattergram



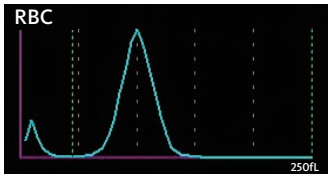
WDF scattergram

WDF (EXT) scattergram

WBC-BF = MN# + PMN#
TC-BF# = WBC-BF + HF-BF#
MN = LY-BF + MO-BF
PMN = NE-BF + EO-BF

* See page 4 for the nomenclature.

Histogram



RBC histogram

The body fluid analysis can only be performed if the analyzer offers the optional available body fluid mode.

Examples of body fluid analysis

Visual differential counts

The cells were differentiated into 5 types of leukocytes, macrophages, mesothelial cells and others, from the morphological characteristics revealed by May Grünwald Giemsa-stained samples.

Caution

Fibrin sometimes gets deposited while analyzing a body fluid. Therefore, EDTA may be added at sample collection, if necessary, as an anticoagulant before performing the measurements.
Perform analysis on the Sysmex analyzer immediately without any delay after obtaining the specimen in the laboratory.
The results of automated body fluid analysis may be used in conjunction with other lab results and clinical symptoms of the patients to assist the clinician in making a diagnosis.

Subarachnoid hemorrhage (1)

Information from XN-Series

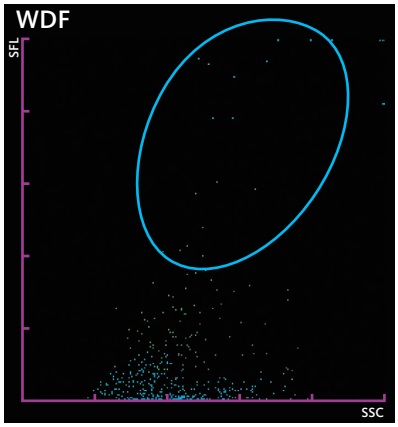
WBC-BF	0.010	10^9/L	*			
RBC-BF	0.001	10^{12}/L				
MN	0.006	10^9/L	*	60.0	%	*
PMN	0.004	10^9/L	*	40.0	%	*
TC-BF	0.012	10^9/L	*			

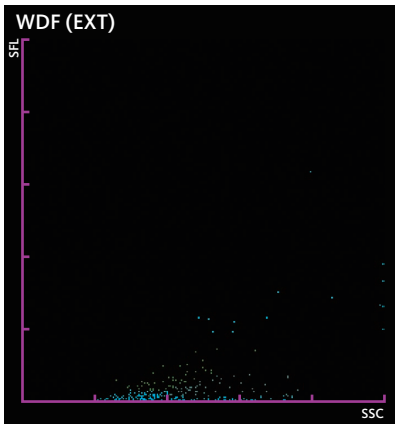
Research parameters

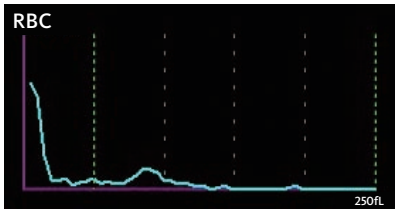
LY-BF	0.004	10^9/L	*	40.0	%	*
MO-BF	0.002	10^9/L	*	20.0	%	*
NE-BF	0.003	10^9/L	*	30.0	%	*
EO-BF	0.001	10^9/L	*	10.0	%	*
HF-BF	0.002	10^9/L	*	20.0	/100WBC	*
RBC-BF2	0.0014	10^{12}/L				

Flags

WBC Flag(s)
WBC Abn Scattergram







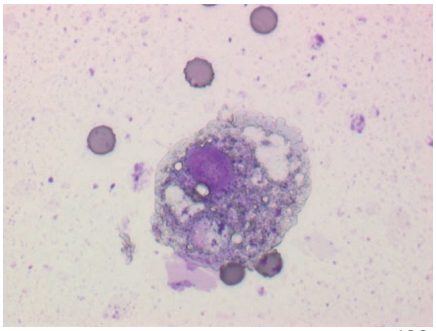
Point

The nucleated cell count is low and there are no distinctive clusters of mononuclear cells (MN) or polymorphonuclear cells (PMN) in the WDF scattergram. The scanty plots (○) in the mononuclear - high fluorescence area (HF-BF area) are considered to be the macrophages seen on the cytospin smears. In case of such samples with a low nucleated cell count and because the WBC Abnormal Scattergram Flag was triggered, we have to review the visual differential count for cell classification.

Case history

A 73-year-old female. She came to the hospital with headache and vomiting as the main complaints. The findings of CT scan of the head led to the diagnosis of subarachnoid hemorrhage. The cerebrospinal fluid was also sent to the lab for analysis.

Cytospin smear (May-Giemsa staining)



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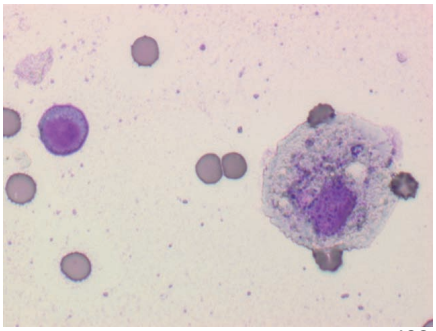

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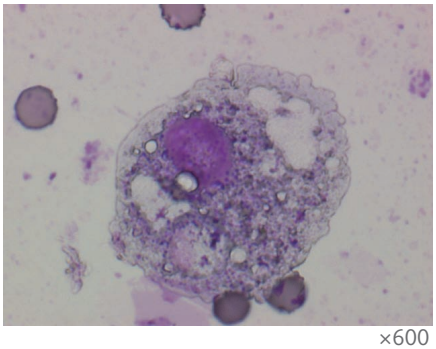

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Point

There are few nucleated cells, but a number of macrophages can be observed phagocytosing hemosiderin. Because of the yellow-tinged appearance (xanthochromia) of the fluid with normal protein level, we conclude that this is possibly a case of old subarachnoid hemorrhage. The specimen is slightly turbid because of nonbacterial meningeal reactions.

Visual differential counts

Nucleated cell count	17 /μL
Mononuclear cells	15 /μL
Lympho	3 /μL
Macrophages	12 /μL
Polymorphonuclear cells	2 /μL
Neutro	2 /μL
Eosino	0 /μL
Baso	0 /μL

Other tests

External appearance (color and transparency)	Yellow and mildly turbid
Red blood cells	A few
Protein(mg/dL)	23
Sugar(mg/dL)	76
Cl (mEq/L)	122

Subarachnoid hemorrhage (2)

Information from XN-Series

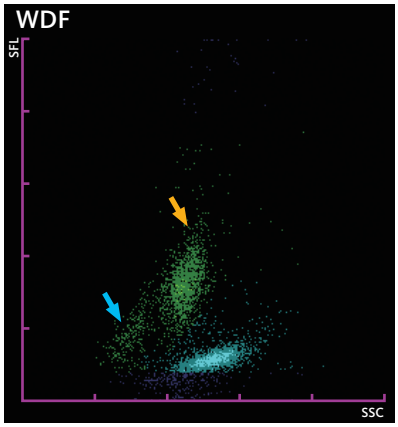
WBC-BF	0.394	10^9/L	
RBC-BF	0.059	10^{12}/L	
MN	0.178	10^9/L	45.2 %
PMN	0.216	10^9/L	54.8 %
TC-BF	0.397	10^9/L	

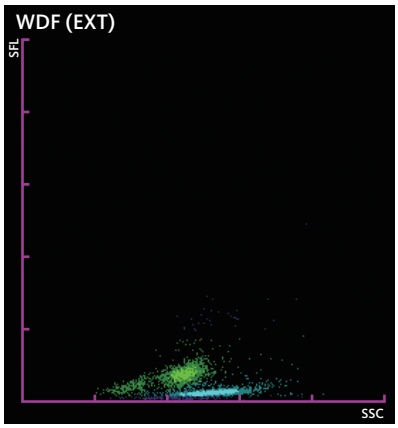
Research parameters

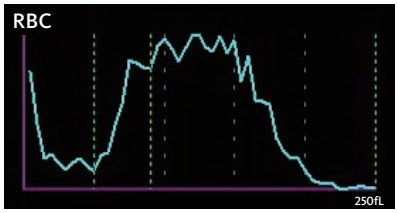
LY-BF	0.041	10^9/L	10.4 %
MO-BF	0.137	10^9/L	34.8 %
NE-BF	0.214	10^9/L	54.3 %
EO-BF	0.002	10^9/L	0.5 %
HF-BF	0.003	10^9/L	0.8 /100WBC
RBC-BF2	0.0590	10^{12}/L	

Flags

WBC Flag(s)







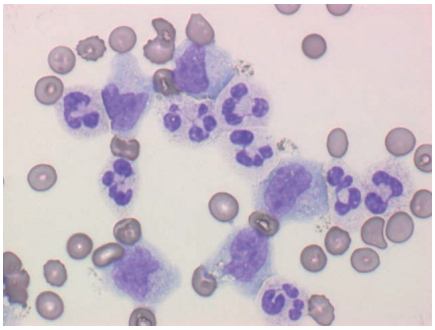
Point

The XN nucleated cell count is slightly higher than reported by the visual cell count. The WDF scattergram has two clusters of mononuclear cells (MN) which correspond to lymphocytes (⬆) and monocytes (⬆). The XN differential count roughly matches with the visual differential count. The red blood cells included in the sample are dissolved by the lysing agent, and thus do not affect the nucleated cell count.

Case history

A 63-year-old female. She was brought in as an emergency case after she fell down with severe headache and disturbed consciousness. The cerebrospinal fluid was analyzed because subarachnoid hemorrhage was suspected.

Cytospin smear (May-Giemsa staining)



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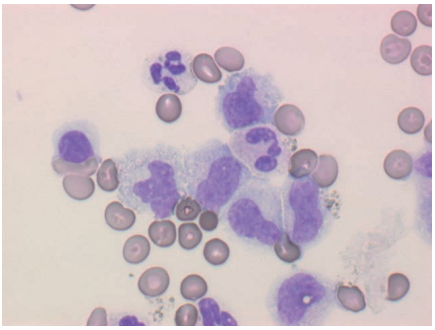

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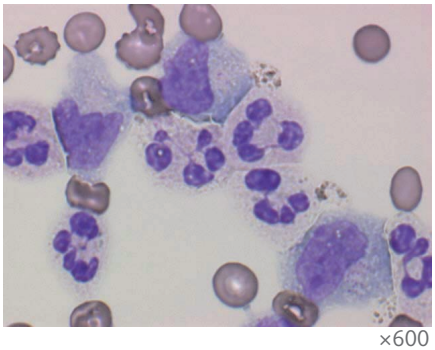

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Point

The count of nucleated cells is increased with a high fraction of the neutrophil and monocyte. The patient seems to be in an early stage of the hemorrhage as the fluid is reddish in color and has a positive reaction (3+) for red blood cell. The high protein level is very likely caused by intermixing of plasma protein due to the hemorrhage into the CSF.

Visual differential counts

Nucleated cell count	253	/μL
Mononuclear cells	50	%
Lympho	6	%
Mono	44	%
Polymorphonuclear cells	50	%
Neutro	50	%
Eosino	0	%
Baso	0	%

Other tests

External appearance (color and transparency)	Red and turbid
Red blood cells	3+
Protein(mg/dL)	147
Sugar(mg/dL)	46
Cl (mEq/L)	131

Bacterial meningitis

Information from XN-Series

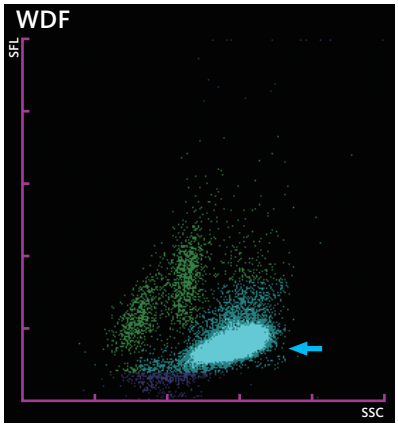
WBC-BF	4.912	10^9/L	
RBC-BF	0.004	10^{12}/L	
MN	0.179	10^9/L	3.6 %
PMN	4.733	10^9/L	96.4 %
TC-BF	4.913	10^9/L	

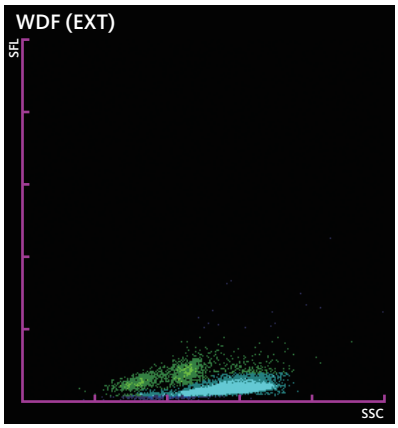
Research parameters

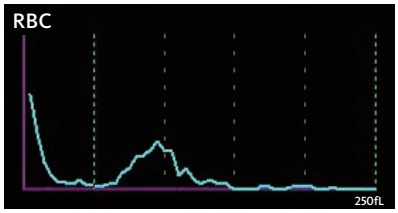
LY-BF	0.074	10^9/L	1.5 %
MO-BF	0.105	10^9/L	2.1 %
NE-BF	4.722	10^9/L	96.2 %
EO-BF	0.011	10^9/L	0.2 %
HF-BF	0.001	10^9/L	0.0 /100WBC
RBC-BF2	0.0038	10^{12}/L	

Flags

WBC Flag(s)







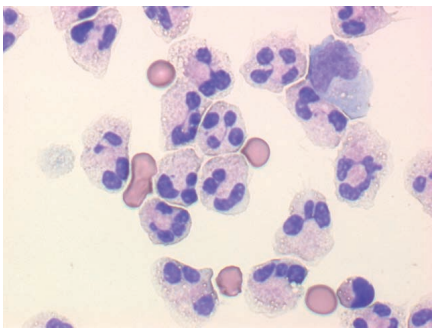
Point

There are many nucleated cells. From the WDF scattergram pattern, it appears that almost all of them are polymorphonuclear cells (neutrophils, ⬆). The increase in neutrophils suggests the presence of a bacterial infection.

Case history

A 59-year-old male. Craniotomy for hematoma evacuation and ventricular drainage were performed to treat cerebellar hemorrhage. After the surgical procedures, subcutaneous leakage of spinal fluid was noticed and meningitis was detected simultaneously.

Cytospin smear (May-Giemsa staining)



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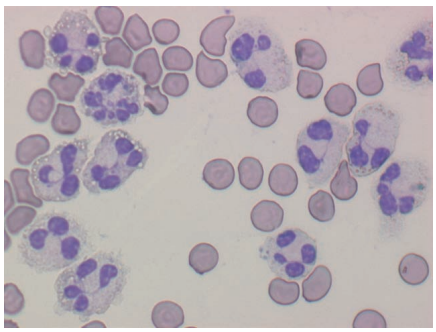

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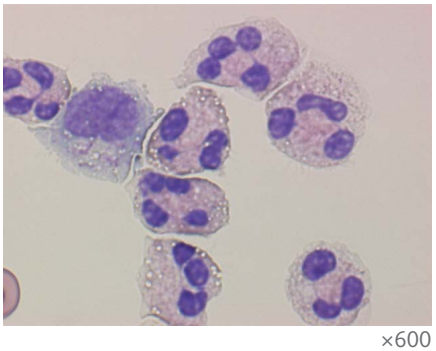

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Point

The count of nucleated cells is high and most of them are neutrophils, and a few monocytes were observed.
The fluid appears turbid due to high cell counts. The dominance of neutrophils in the cytospin smears and the high protein level are compatible with bacterial meningitis. The ratio of the sugar level with respect to the blood sugar level is low at 0.5 (normal range: 0.6 – 0.8). The sugar level usually becomes low in bacterial meningitis due to anaerobic glycolysis by the bacteria and neutrophils.

Visual differential counts

Nucleated cell count	5,500/μL
Mononuclear cells	11 %
Lympho	3 %
Mono	8 %
Polymorphonuclear cells	89 %
Neutro	88 %
Eosino	1 %
Baso	0 %

Other tests

External appearance (color and transparency)	Yellow and turbid
Red blood cells	1+
Protein(mg/dL)	928
Sugar(mg/dL)	73
Cl (mEq/L)	105

HTLV-1-associated myelopathy (HAM)

Information from XN-Series

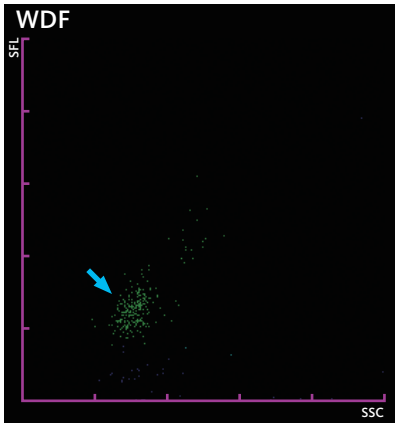
WBC-BF	0.024	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.024	10^9/L	100.0 %
PMN	0.000	10^9/L	0.0 %
TC-BF	0.024	10^9/L	

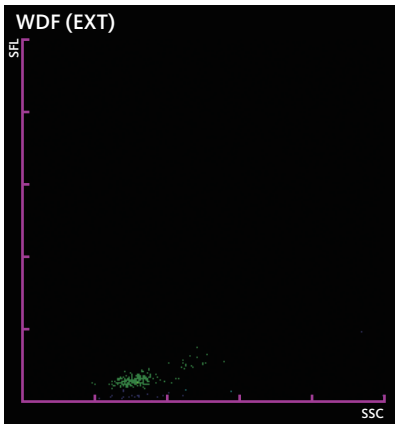
Research parameters

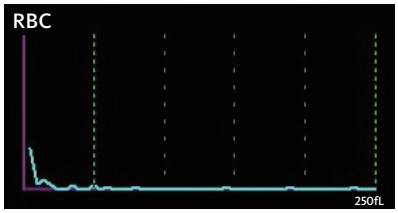
LY-BF	0.022	10^9/L	91.7 %
MO-BF	0.002	10^9/L	8.3 %
NE-BF	0.000	10^9/L	0.0 %
EO-BF	0.000	10^9/L	0.0 %
HF-BF	0.000	10^9/L	0.0 /100WBC
RBC-BF2	0.0001	10^{12}/L	

Flags

WBC Flag(s)







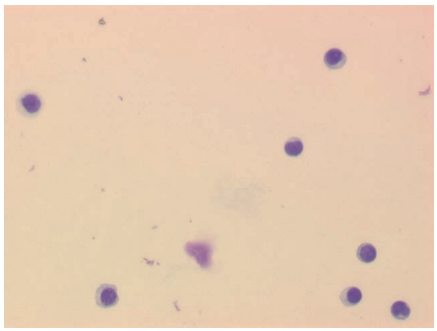
Point

The XN reported a slightly increased WBC concentration and more than 90% of the cells were lymphocytes (LY-BF). Although the number of cells is not large, we can distinguish a cluster corresponding to lymphocytes on the WDF scattergram (⬆). The dominance of lymphocytes, suggests infiltration of abnormal lymphocytes or a viral infection.

Case history

A 36-year-old male. This patient had a disturbance of urination and was hospitalized for suspected myelopathy. A blood test showed that he was positive for HTLV-1 antibody. The cerebrospinal fluid was tested, as HTLV-1-associated myelopathy (HAM) was suspected.

Cytospin smear (May-Giemsa staining)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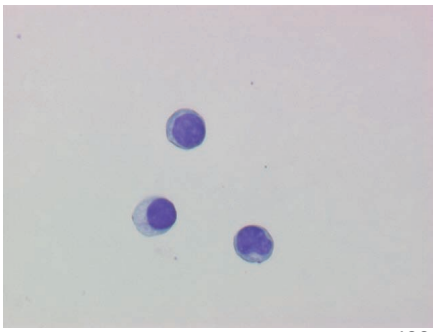
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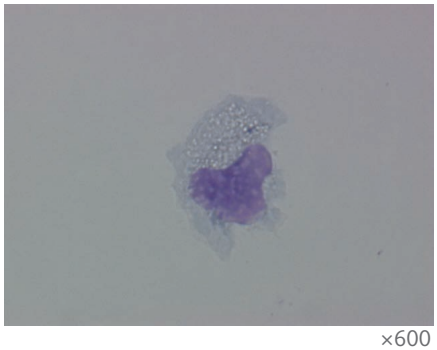
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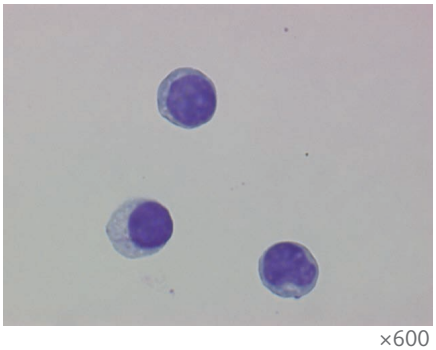

×600

Point

There are only a few nucleated cells and lymphocytes are dominant. There are no ATL-like flower cells, which typically have nuclei notched into flower petal-like shapes. In HAM, the patient sometimes shows a mild to moderate increase in cell counts, mostly in lymphocytes. The biochemistry test results of this cerebrospinal fluid are normal.

Visual differential counts

Nucleated cell count	26 /μL
Mononuclear cells	26 /μL
Lympho	22 /μL
Mono	4 /μL
Polymorphonuclear cells	0 /μL
Neutro	0 /μL
Eosino	0 /μL
Baso	0 /μL

Other tests

External appearance (color and transparency)	Colorless and transparent
Red blood cells	—
Protein(mg/dL)	20
Sugar(mg/dL)	69
Cl (mEq/L)	127

Brain tumor

Information from XN-Series

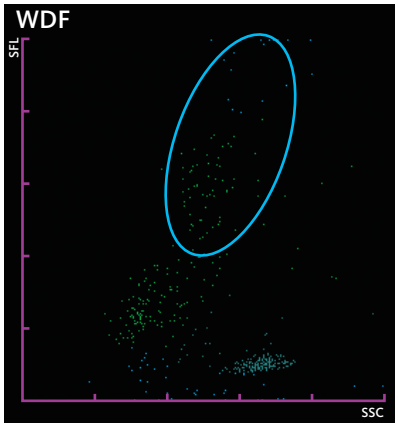
WBC-BF	0.036	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.019	10^9/L	52.8 %
PMN	0.017	10^9/L	47.2 %
TC-BF	0.038	10^9/L	

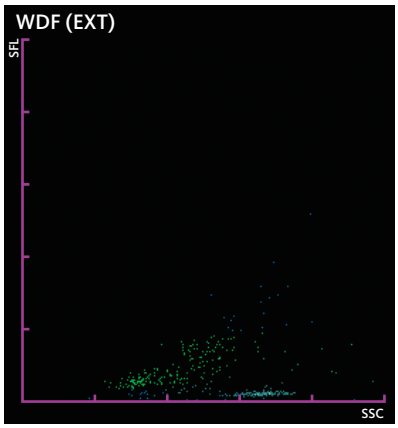
Research parameters

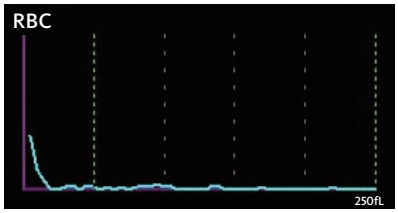
LY-BF	0.009	10^9/L	25.0 %
MO-BF	0.010	10^9/L	27.8 %
NE-BF	0.006	10^9/L	16.6 %
EO-BF	0.011	10^9/L	30.6 %
HF-BF	0.002	10^9/L	5.6 /100WBC
RBC-BF2	0.0002	10^{12}/L	

Flags

WBC Flag(s)







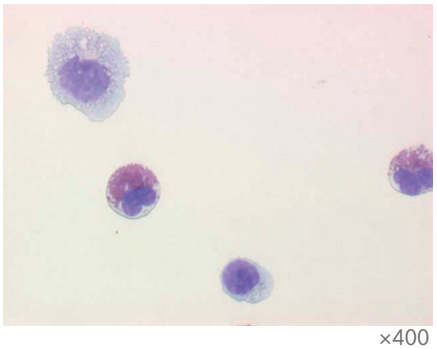
Point

An increased nucleated cell concentration was present in the CSF Sample. In the XN data, the monocyte count (MO-BF), a research parameter, is 10/μL, whereas that in the visual differential count is 2/μL. Therefore the large atypical cells seen in the cytospin smear are considered to be plotted in the monocyte area as well as in the high fluorescence (HF-BF) area (○) of the WDF scattergram. The increased HF-BF concentration, indicates abnormal cells being present in the sample, which requires a morphological review by microscope.

Case history

A 10-month-old boy was brought to the hospital because of fever and hematuria. Ultrasonography revealed a mass in the right kidney, which was surgically removed. Histopathological examination of the mass led to the diagnosis of malignant rhabdoid tumor of the kidney. As this disease often has a brain tumor as a complication, the head was examined and the cerebrospinal fluid analyzed.

Cytospin smear (May-Giemsa staining)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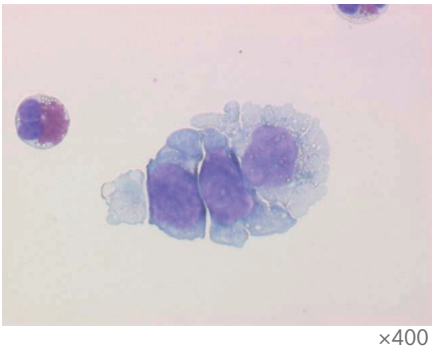
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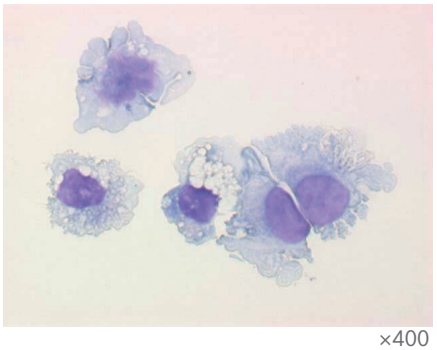
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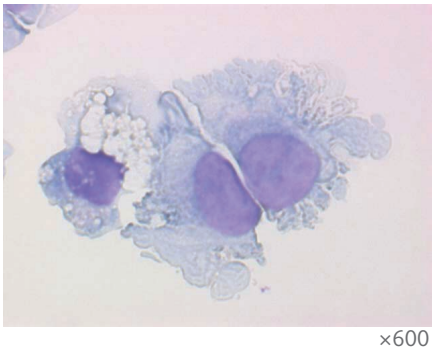

×600

Point

The cytospin smear shows an increase in eosinophils and large atypical cells. The atypical cells are oval or round, and the cytoplasm is non-uniformly stained blue. The endoplasmic reticulums are irregular in shape, some showing a folded appearance. Many cells have delicate nuclear reticulums, and nucleoli. Some cells have increased amounts of chromatin. The blood-brain barrier is impaired because of the brain tumor and the permeability of serum protein is elevated, which migrates into the cerebrospinal fluid, increasing the protein level of the CSF.

Visual differential counts

Nucleated cell count	47 /μL
Mononuclear cells	12 /μL
Lympho	10 /μL
Mono	2 /μL
Polymorphonuclear cells	28 /μL
Neutro	2 /μL
Eosino	26 /μL
Baso	0 /μL
Atypical cells	7 /μL

Other tests

External appearance (color and transparency)	Yellow and mildly turbid
Red blood cells	A few
Protein(mg/dL)	378
Sugar(mg/dL)	61
Cl (mEq/L)	113

Acute lymphoblastic leukemia with meningeal infiltration

Information from XN-Series

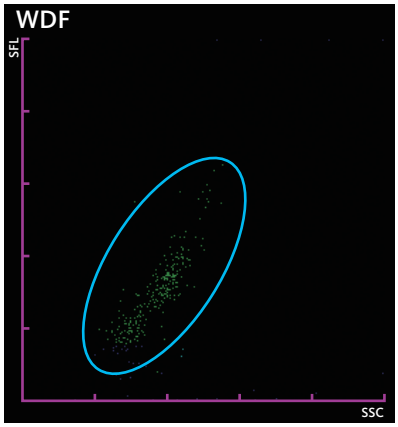
WBC-BF	0.024	10^9/L		
RBC-BF	0.000	10^{12}/L		
MN	0.024	10^9/L	100.0	%
PMN	0.000	10^9/L	0.0	%
TC-BF	0.025	10^9/L		

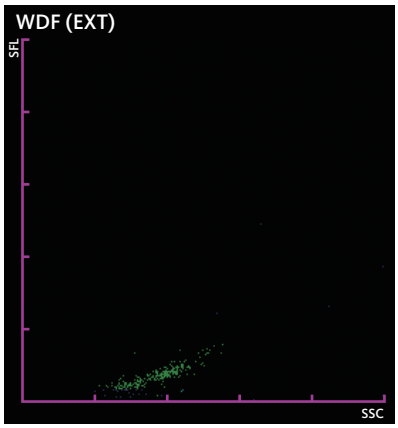
Flags

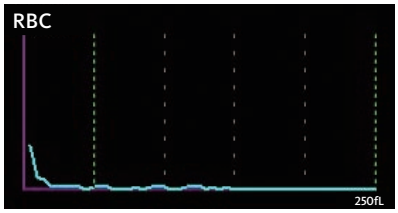
WBC Flag(s)

Research parameters

LY-BF	0.020	10^9/L	83.3	%
MO-BF	0.004	10^9/L	16.7	%
NE-BF	0.000	10^9/L	0.0	%
EO-BF	0.000	10^9/L	0.0	%
HF-BF	0.001	10^9/L	4.2	/100WBC
RBC-BF2	0.0002	10^{12}/L		







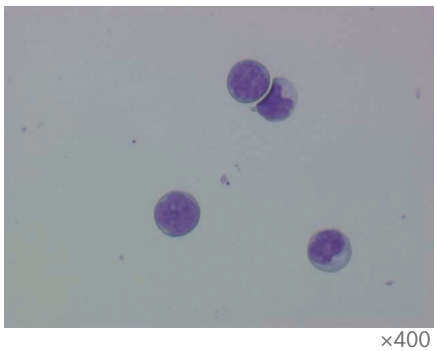
Point

There are a few nucleated cells, and 100% of them are mononuclear cells. There is a mononuclear (MN) cell cluster (○) in the WDF scattergram also. This cluster is considered to represent a population that includes the leukemic cells seen in the cytospin smear.

Case history

An 18-year-old male. He was suffering from acute lymphoblastic leukemia which occurred 2 years ago. He came to the hospital with the complaint of right-sided facial nerve paralysis. The cerebrospinal fluid was tested to examine central nervous system infiltration by leukemic cells.

Cytospin smear (May-Giemsa staining)



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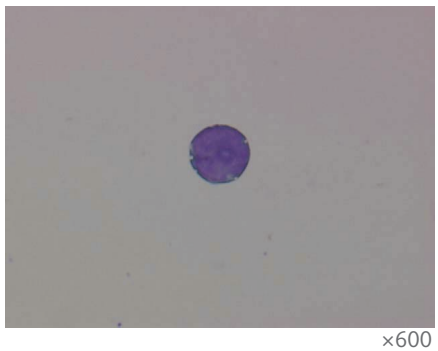

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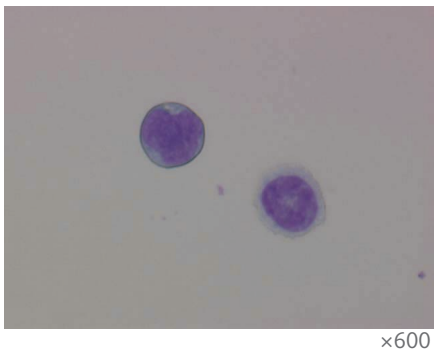

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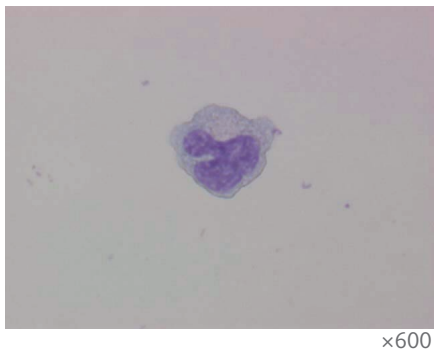


×600

Point

The cytospin smear shows leukemic cells (blast cells) , which have a high N/C ratio, delicate nuclear reticulums, and nucleoli, among the normal lymphocytes and monocytes.
In meningeal infiltration by leukemic cells, the protein level is often elevated mildly while the sugar level is low in the cerebrospinal fluid. The sugar level appears to be slightly high but the ratio of the sugar level with respect to that of the blood is only 0.4 (normal range: 0.6 – 0.8), because of the high blood sugar level.

Visual differential counts

Nucleated cell count	32 /μL
Mononuclear cells	14 /μL
Lympho	10 /μL
Macrophages	4 /μL
Polymorphonuclear cells	0 /μL
Neutro	0 /μL
Eosino	0 /μL
Baso	0 /μL
Blast cells	18 /μL

Other tests

External appearance (color and transparency)	Colorless and mildly turbid
Red blood cells	—
Protein(mg/dL)	100
Sugar(mg/dL)	87
Cl (mEq/L)	123

Bacterial pleuritis

Information from XN-Series

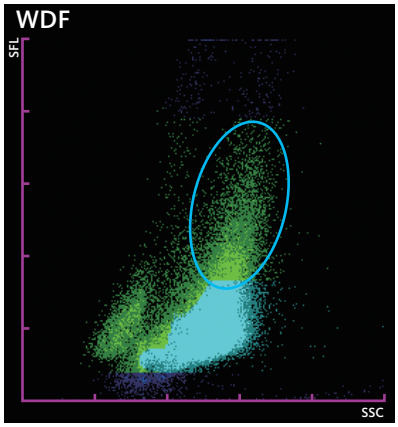
WBC-BF	5.247	10^9/L	
RBC-BF	0.007	10^{12}/L	
MN	1.480	10^9/L	28.2 %
PMN	3.767	10^9/L	71.8 %
TC-BF	5.276	10^9/L	

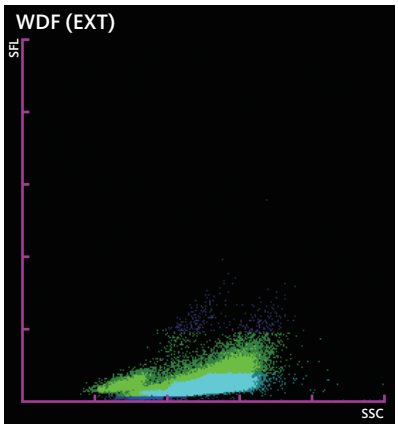
Research parameters

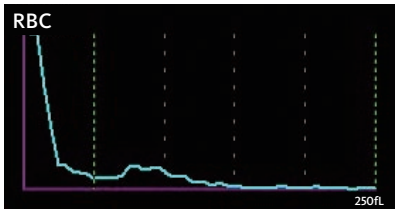
LY-BF	0.591	10^9/L	11.3 %
MO-BF	0.889	10^9/L	16.9 %
NE-BF	3.763	10^9/L	71.7 %
EO-BF	0.004	10^9/L	0.1 %
HF-BF	0.029	10^9/L	0.6 /100WBC
RBC-BF2	0.0072	10^{12}/L	

Flags

WBC Flag(s)







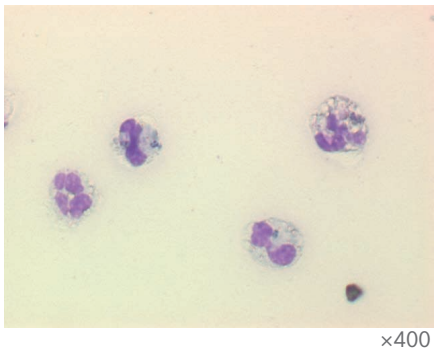
Point

There is an increase in the number of nucleated cells. Polymorphonuclear cells (neutrophils) are dominant, which is a characteristic of bacterial infection. The cytospin smear shows that neutrophils which are phagocytosing bacteria. These PMN cells are considered to be plotted in the high fluorescence area (○) on the WDF scattergram. Mononuclear cells, including macrophages, are often plotted in this area, and the analysis algorithm classifies phagocytosing neutrophils as mononuclear cells in this case (shown as green dots).

Case history

An 86-year-old female. Leucocytosis, enhanced inflammatory response, and pleural effusion were detected while she was under treatment for cerebral contusion. The culture test for common bacteria revealed the presence of *Staphylococcus aureus*.

Cytospin smear (May-Giemsa staining)



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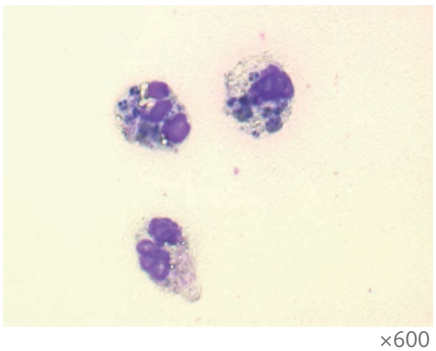

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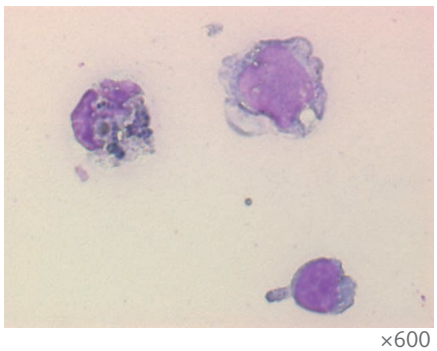

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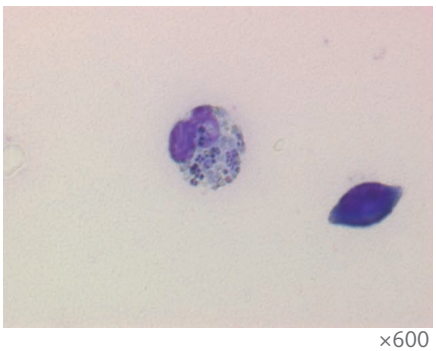


×600

Point

There is a marked increase in the number of nucleated cells in the pleural fluid. Most of them are neutrophils and many neutrophils are observed phagocytosing bacteria. Pleural effusion is considered to be exudative one caused by bacterial pleuritis, because of the protein level of 4.5 g/dL (3 g/dL or more), the pleural fluid : serum total protein ratio of 1.2 (0.5 or more), pleural fluid : serum LD ratio of 1.0 (0.6 or more), specific gravity of 1.020 (1.018 or more), and neutrophil-dominated increase in cells. The culture result is positive for common bacteria.

Visual differential counts

Nucleated cell count	5,291/μL
Mononuclear cells	13 %
Lympho	10 %
Macrophages	3 %
Polymorphonuclear cells	87 %
Neutro	87 %
Eosino	0 %
Baso	0 %
Bacteria(+)	

Other tests

Specific gravity	1.020
Total protein(g/dL)	4.5
Albumin(g/dL)	2.2
A/G	1.0
LD (U/L)	255
Sugar(mg/dL)	69

Pleural empyema

Information from XN-Series

WBC-BF	9.897	10^9/L	*		
RBC-BF	0.011	10^{12}/L			
MN	0.918	10^9/L	*	9.3 %	*
PMN	8.979	10^9/L	*	90.7 %	*
TC-BF	9.901	10^9/L	*		

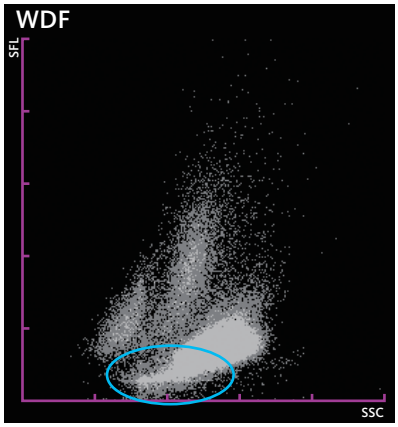
Research parameters

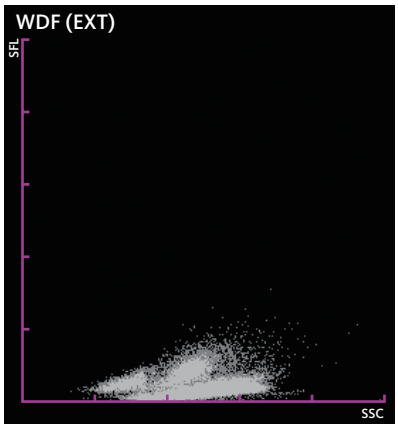
LY-BF	0.402	10^9/L	*	4.1 %	*
MO-BF	0.516	10^9/L	*	5.2 %	*
NE-BF	8.953	10^9/L	*	90.4 %	*
EO-BF	0.026	10^9/L	*	0.3 %	*
HF-BF	0.004	10^9/L	*	0.0 /100WBC	*
RBC-BF2	0.0110	10^{12}/L			

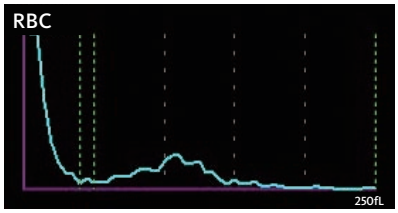
Flags

WBC Flag(s)

WBC Abn Scattergram







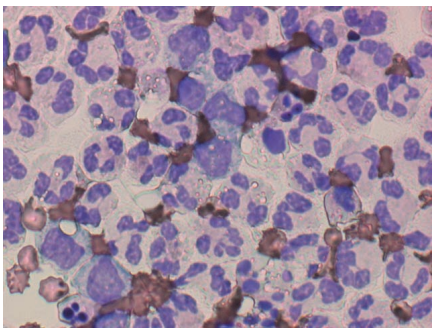
Point

There is a marked increase in the number of nucleated cells. Polymorphonuclear cells (neutrophils) are dominant because of the bacterial infection. On the WDF scattergram, the debris and white blood cell clusters are poorly separated (○) and the “WBC Abn Scattergram” flag is displayed. The PMN cluster which is overlapped with the debris cluster is often seen when there is a marked increase in white blood cells. This is often caused by excessive particles in the debris area due to cell destruction. The analysis should preferably be done as soon as possible after sampling, as the cells are likely to be more easily destroyed over time.

Case history

An 82-year-old female. The patient repeatedly experienced aspiration pneumonia. She was suffering from *Staphylococcus aureus infection*, which led to empyema of the right lung.

Cytospin smear (May-Giemsa staining)



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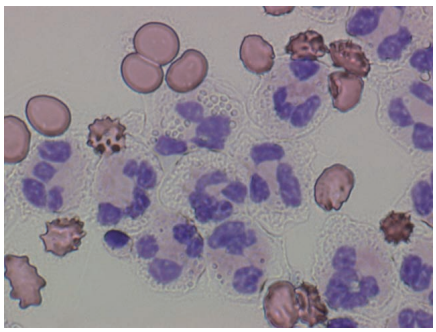

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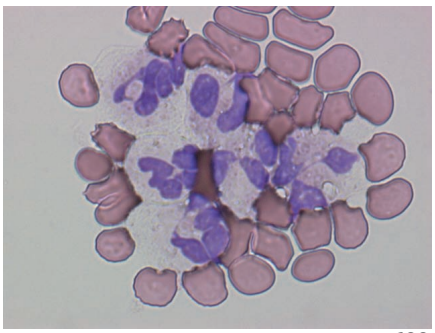


×600

Point

There is an increase in nucleated cells in the pleural fluid. Most of them are neutrophils.

The purulence of the sample, neutrophil-dominated increase in white blood cells, the pH of 7.3 (7.0 or more), the low sugar level (40 mg/dL or less), high LD value (1000 U/L or more) and the culture result that is positive for common bacteria, all suggest bacterial pleural empyema as a complication of pneumonia.

Visual differential counts

Nucleated cell count	9,950/μL
Mononuclear cells	16 %
Lympho	9 %
Mono	7 %
Polymorphonuclear cells	84 %
Neutro	83 %
Eosino	1 %
Baso	0 %

Other tests

Specific gravity	1.024
Total protein(g/dL)	3.0
Albumin(g/dL)	1.7
A/G	0.4
LD (U/L)	1191
Sugar(mg/dL)	34

Tuberculous pleuritis

Information from XN-Series

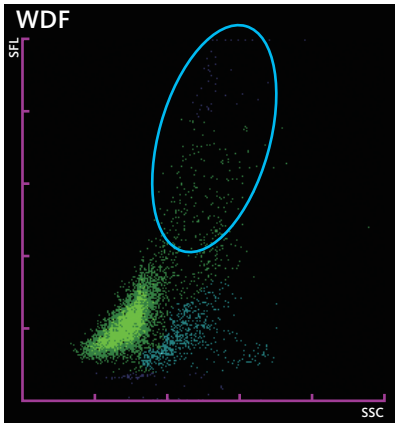
WBC-BF	0.790	10^9/L	
RBC-BF	0.001	10^{12}/L	
MN	0.728	10^9/L	92.1 %
PMN	0.062	10^9/L	7.9 %
TC-BF	0.794	10^9/L	

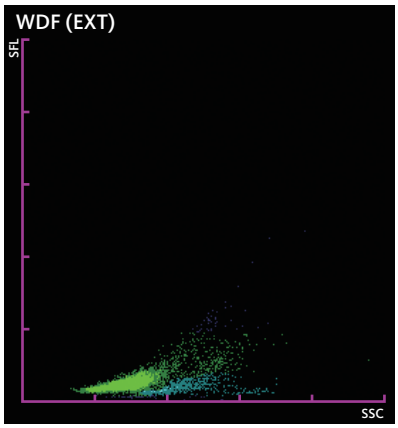
Research parameters

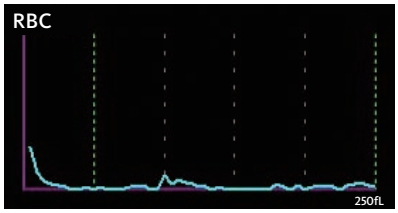
LY-BF	0.700	10^9/L	88.6 %
MO-BF	0.028	10^9/L	3.5 %
NE-BF	0.059	10^9/L	7.5 %
EO-BF	0.003	10^9/L	0.4 %
HF-BF	0.004	10^9/L	0.5 /100WBC
RBC-BF2	0.0009	10^{12}/L	

Flags

WBC Flag(s)







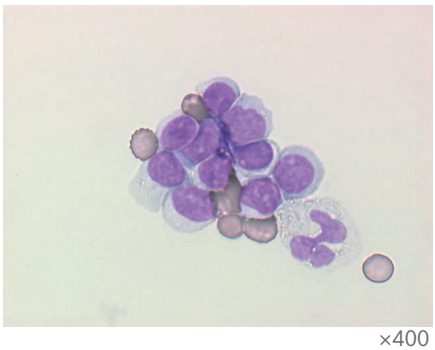
Point

There are many nucleated cells in the pleural fluid. Mononuclear cells (lymphocytes) are predominant. The increase in lymphocytes is a sign that is consistent with tuberculous pleuritis. The cells plotted in the mononuclear cells (MN) – high fluorescence (HF-BF) area of the WDF scattergram are considered to be atypical lymphocytes observed in the cytospin smear (○).

Case history

A 77-year-old male. He came to the hospital because of chest pain. Chest X-rays showed prominent accumulation of pleural fluid in the left lung. As the pleural fluid was high in adenosine deaminase (ADA) levels and was positive for interferon-γ release (quantiFERON® test), tuberculous pleuritis was suspected. A PCR test confirmed that the sample was positive for tubercle bacillus-DNA (TB-DNA).

Cytospin smear (May-Giemsa staining)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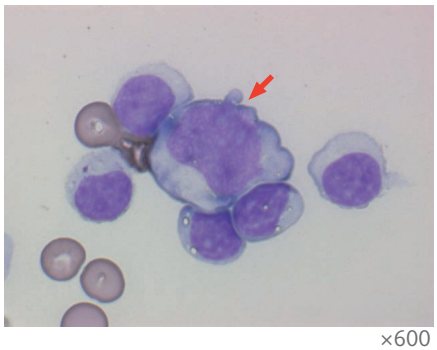
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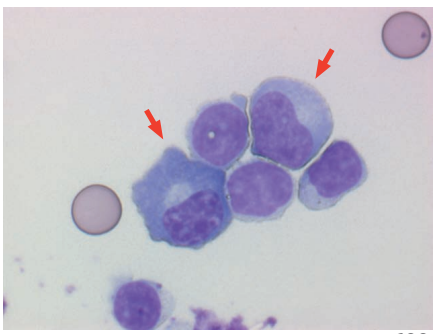
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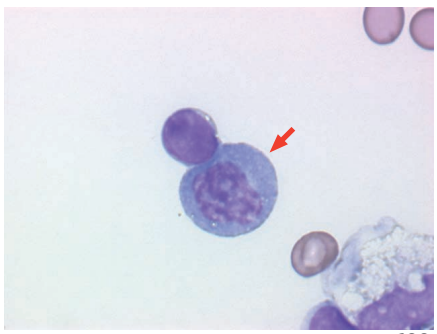

×600

Point

There is an increase in the number of nucleated cells. Most of them are lymphocytes. A few large atypical lymphocytes with strongly basophilic cytoplasm are visible in the cytospin smear (⬆).
The total protein of 4.9 g/dL (3 g/dL or more), the pleural fluid : serum total protein ratio of 0.6 (0.5 or more), and pleural fluid : serum LD ratio of 2.1 (0.6 or more) are all suggestive of exudative pleural effusion. This case is diagnosed as tuberculous pleuritis, based on the lymphocyte-dominated increase in cells, a high ADA level, and a positive PCR test result for TB-DNA.

Visual differential counts

Nucleated cell count	860 /μL
Mononuclear cells	98 %
Lympho	86 %
Mono	12 %
Polymorphonuclear cells	1%
Neutro	1 %
Eosino	0 %
Baso	0 %
Atypical lymphocytes	1 %

Other tests

Specific gravity	N.T.
Total protein(g/dL)	4.9
Albumin(g/dL)	1.7
A/G	0.5
LD (U/L)	326
Sugar(mg/dL)	66
ADA (U/L)	98.1

Lung cancer

Information from XN-Series

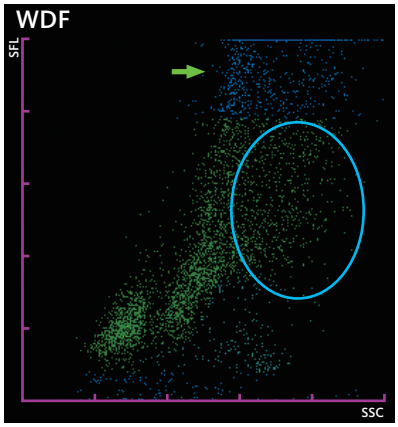
WBC-BF	0.320	10^9/L	
RBC-BF	0.001	10^{12}/L	
MN	0.299	10^9/L	93.5 %
PMN	0.021	10^9/L	6.5 %
TC-BF	0.401	10^9/L	

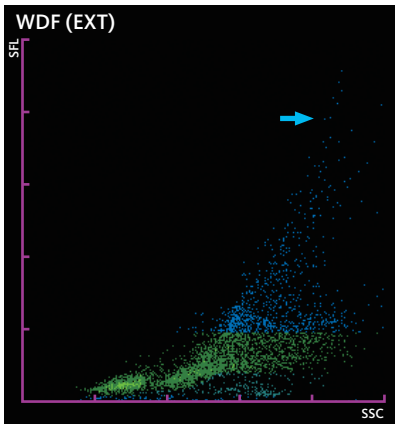
Research parameters

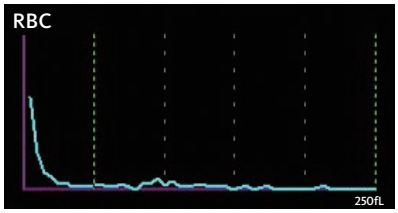
LY-BF	0.103	10^9/L	32.2 %
MO-BF	0.196	10^9/L	61.3 %
NE-BF	0.015	10^9/L	4.6 %
EO-BF	0.006	10^9/L	1.9 %
HF-BF	0.081	10^9/L	25.3 /100WBC
RBC-BF2	0.0007	10^{12}/L	

Flags

WBC Flag(s)







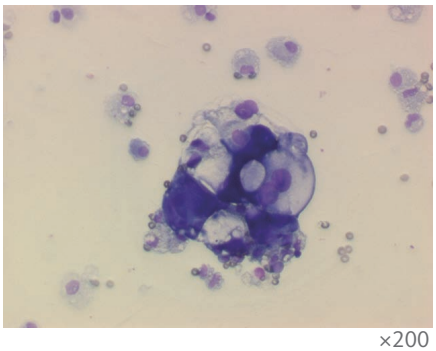
Point

Some particles are plotted in the intense side-scattered light area of the WDF scattergram (○). Some of the macrophages seen in the cytospin smear are considered to be plotted in this area. Moreover, there is a large number of cells plotted in the high fluorescence area (HF-BF area) (⬆), and the dots can be seen into the upper region of the WDF (EXT) scattergram as well (⬆). These are apparently some of the large-sized or aggregated tumor cells seen in the cytospin smear.

Case history

A 60-year-old male. Accumulation of pleural fluid was noticed during treatment of cancer of the right lung.

Cytospin smear (May-Giemsa staining)



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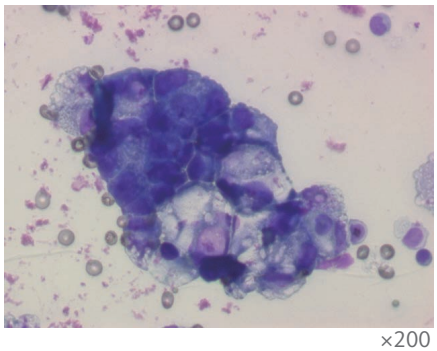

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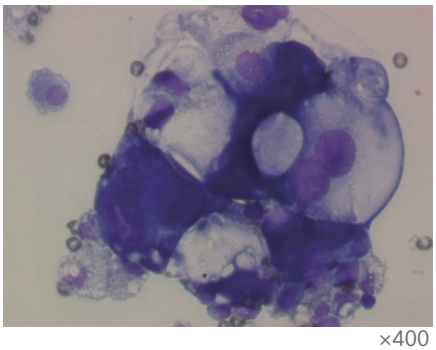

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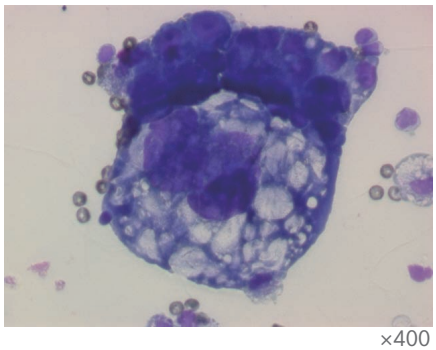


×400

Point

Aggregates of tumor cells can be seen. The tumor cells are extremely large in size, anisocytosis, and a low N/C ratio. The cytoplasmic margins appear thickened. The chromatin is coarse and the nucleoli are distinct; some tumor cells are multinucleated. The cytoplasm is basophilic and the whitish unfilled-looking parts of the cells seem to suggest the presence of mucus.
The specific gravity of 1.029 (1.018 or more), the total protein of 4.1 g/dL (3 g/dL or more), and the pleural fluid: serum total protein ratio of 0.8 (0.5 or more), are all suggestive of exudative pleural effusion although the LD level is slightly low. Tumor infiltration to pleura is highly suggested.

Visual differential counts

Nucleated cell count	354 /μL
Mononuclear cells	82 %
Lympho	13 %
Mono+Macrophages	69 %
Polymorphonuclear cells	3 %
Neutro	2 %
Eosino	1 %
Baso	0 %
Atypical cells	15 %

Other tests

Specific gravity	1.029
Total protein(g/dL)	4.1
Albumin(g/dL)	2.1
A/G	1.1
LD (U/L)	137
Sugar(mg/dL)	107

Congestive heart failure

Information from XN-Series

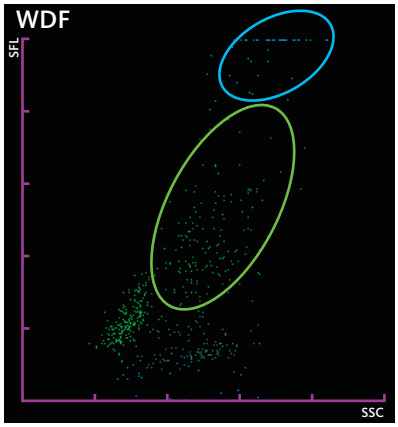
WBC-BF	0.048	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.037	10^9/L	77.1 %
PMN	0.011	10^9/L	22.9 %
TC-BF	0.055	10^9/L	

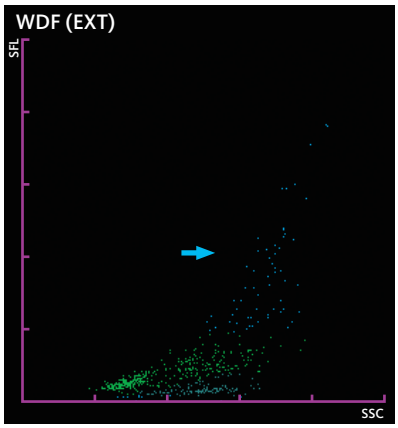
Research parameters

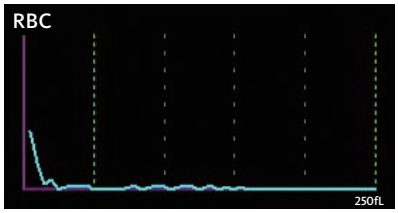
LY-BF	0.023	10^9/L	47.9 %
MO-BF	0.014	10^9/L	29.2 %
NE-BF	0.011	10^9/L	22.9 %
EO-BF	0.000	10^9/L	0.0 %
HF-BF	0.007	10^9/L	14.6 /100WBC
RBC-BF2	0.0002	10^{12}/L	

Flags

WBC Flag(s)







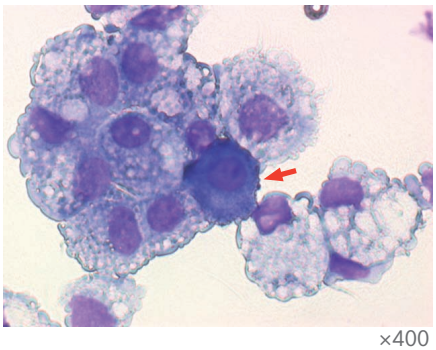
Point

The number of nucleated cells is low compared to the visual differential count. In the WDF scattergram, the monocytes and macrophages are considered to be plotted in the circled area (○), and the mesothelial cells are in the high fluorescence (HF-BF) area (○). The aggregated macrophages seen in the cytospin smear are apparently plotted in the high fluorescence area. The WDF (EXT) scattergram also shows particles plotted into the upper region (⬆). The XN analyzer counts cell aggregates as single cells. This could be the reason why the nucleated cell count by the XN analyzer differed compared to the visual cell count.

Case history

A 74-year-old male with diabetes. He developed diabetic ketoacidosis, septic shock and left-sided heart failure and was admitted to hospital. Accumulation of pleural fluid was detected during the treatment.

Cytospin smear (May-Giemsa staining)



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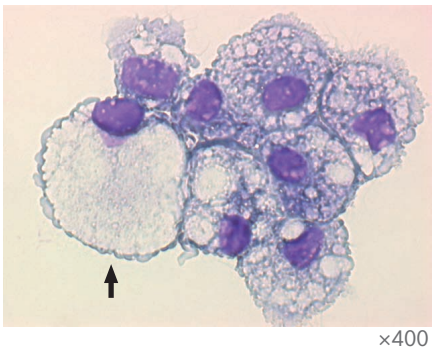

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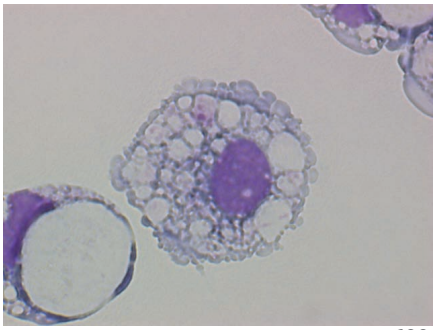

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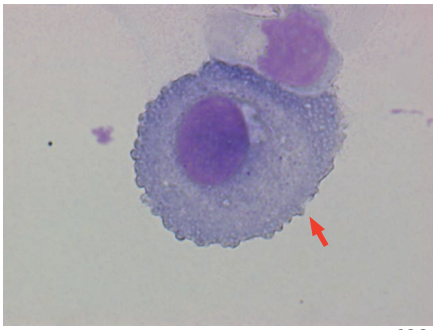


×600

Point

There are aggregates of macrophage on the cytospin smear. The macrophages are large and have many vacuoles. There are also signet ring-like cells with a broad layer of cytoplasm and eccentric nuclei (⬆). Compared to signet ring cells of adenocarcinoma, the cytoplasmic layer of these benign signet ring-like cells appears lighter and thinner, and their nuclei are smaller and have less chromatin amount. The circular cells with a low N/C ratio and a basophilic cytoplasm are mesothelial cells (⬆).

The total protein level of 2.3 g/dL (2.5 g/dL or less), the pleural fluid : serum total protein ratio of 0.4 (less than 0.5), and the pleural fluid : serum LD ratio of 0.6 (=0.6), the sugar level in the same range as the blood sugar level (213 mg/dL), and the presence of macrophages and mesothelial cells in the smears, are all suggestive of transudative pleural effusion caused by congestive cardiac failure.

Visual differential counts

Nucleated cell count	210 /μL
Mononuclear cells	88 %
Lympho	5 %
Mono+Macrophages	83 %
Polymorphonuclear cells	5 %
Neutro	5 %
Eosino	0 %
Baso	0 %
Blast cells	7 %

Other tests

Specific gravity	1.018
Total protein(g/dL)	2.3
Albumin(g/dL)	N.T.
A/G	N.T.
LD (U/L)	259
Sugar(mg/dL)	222

Advanced gastric cancer

Information from XN-Series

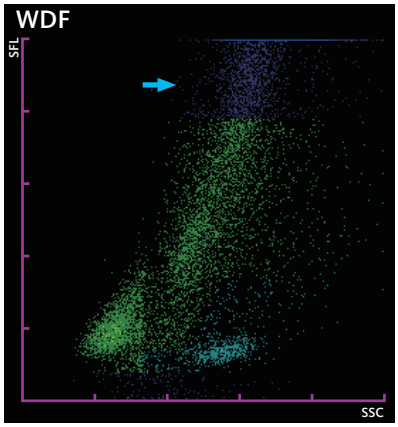
WBC-BF	0.618	10^9/L	
RBC-BF	0.024	10^{12}/L	
MN	0.541	10^9/L	87.6 %
PMN	0.077	10^9/L	12.4 %
TC-BF	0.994	10^9/L	

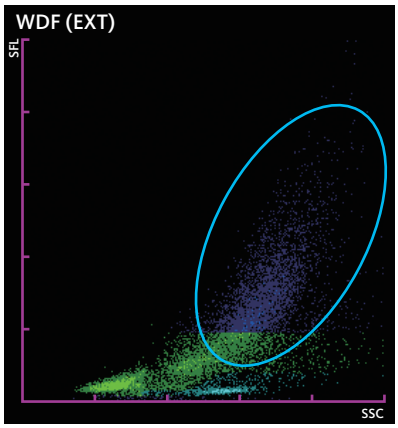
Research parameters

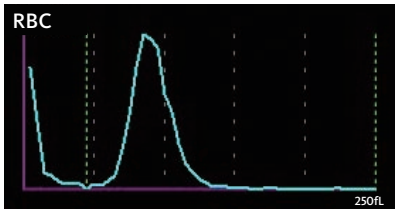
LY-BF	0.250	10^9/L	40.5 %
MO-BF	0.291	10^9/L	47.1 %
NE-BF	0.076	10^9/L	12.2 %
EO-BF	0.001	10^9/L	0.2 %
HF-BF	0.376	10^9/L	60.8 /100WBC
RBC-BF2	0.0244	10^{12}/L	

Flags

WBC Flag(s)







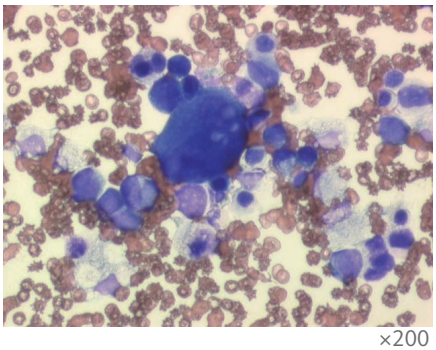
Point

Cells are plotted up to the high fluorescence (HF-BF) area of the WDF scattergram (⬆), and the same trend can be seen in the WDF (EXT) scattergram as well (◯). The tumor cells seen in the cytospin smear are considered to be plotted as the indicated population (◯). The mononuclear cell count is different compared to the results of the visual differential count probably because some of the tumor cells appear in the mononuclear cell area of the XN analyzer.

Case history

A 62-year-old male. Ascites was noticed during treatment of advanced gastric cancer.

Cytospin smear (May-Giemsa staining)



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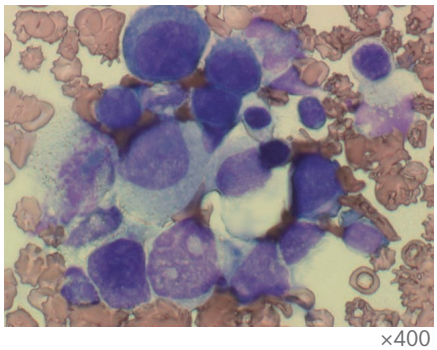

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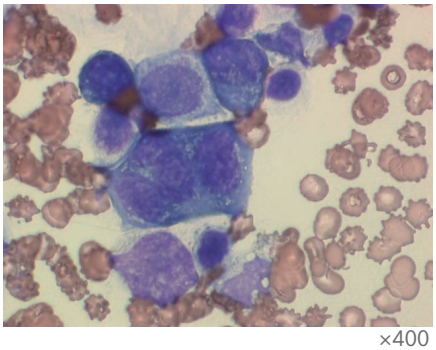


×400

Point

Tumor cell aggregates are seen. The tumor cells have a relatively low N/C ratio and anisocytosis, and their cytoplasmic margins appear thickened. The nuclei are coarse and have distinct nucleoli. Some of the cells are multinucleated. The cytoplasm is basophilic but its staining is non-uniform.
In addition to these findings, the specific gravity of 1.026 (1.018 or more), total protein of 3.6 g/dL (3 g/dL or more), and the bloody ascites fluid, are all suggestive of exudative ascites arising from cancerous peritonitis.

Visual differential counts

Nucleated cell count	844 /μL
Mononuclear cells	51 %
Lympho	36 %
Mono	15 %
Polymorphonuclear cells	11 %
Neutro	11 %
Eosino	0 %
Baso	0 %
Mesothelial cells	1 %
Atypical cells	37 %

Other tests

Specific gravity	1.026
Total protein(g/dL)	3.6
Albumin(g/dL)	N.T.
A/G	N.T.
LD (U/L)	N.T.
Sugar(mg/dL)	N.T.

Liver cirrhosis

Information from XN-Series

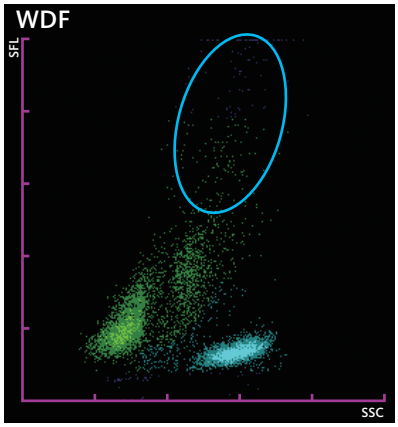
WBC-BF	0.747	10^9/L	
RBC-BF	0.196	10^{12}/L	
MN	0.409	10^9/L	54.7 %
PMN	0.338	10^9/L	45.3 %
TC-BF	0.757	10^9/L	

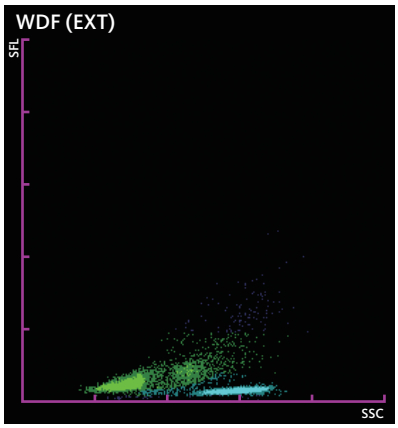
Research parameters

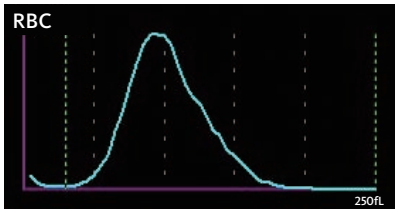
LY-BF	0.314	10^9/L	42.0 %
MO-BF	0.095	10^9/L	12.7 %
NE-BF	0.324	10^9/L	43.4 %
EO-BF	0.014	10^9/L	1.9 %
HF-BF	0.010	10^9/L	1.3 /100WBC
RBC-BF2	0.1963	10^{12}/L	

Flags

WBC Flag(s)







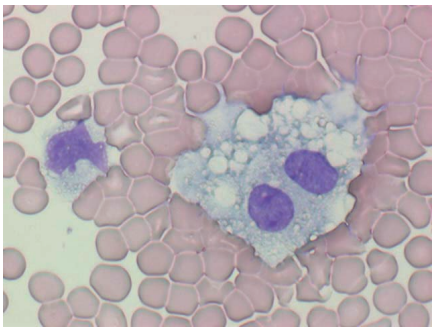
Point

The WDF scattergram shows a few dots in the area of high fluorescence. The macrophages phagocytosing red blood cells and atypical lymphocytes, all seen in the cytospin smear, are considered to be plotted in the marked area (○). The red blood cells contaminated in the sample are lysed by the lysing agent and therefore do not affect the nucleated cell count.

Case history

A 52-year-old male. Ascites was noticed during treatment of alcoholic liver cirrhosis.

Cytospin smear (May-Giemsa staining)



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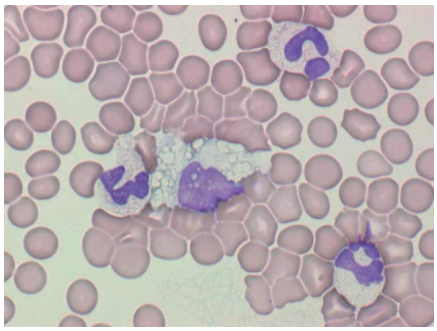

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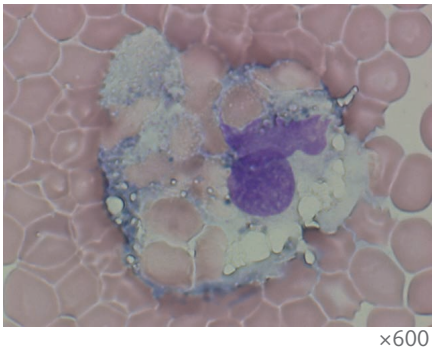

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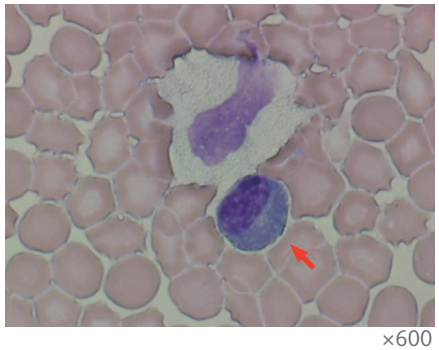


×600

Point

There is a moderate increase in the number of nucleated cells on the cytospin smear. Neutrophils, lymphocytes, and macrophages are seen.
Macrophages phagocytosing red blood cells and atypical lymphocytes with strongly basophilic cytoplasm (⬆) are also seen.
The specific gravity of 1.014 (1.015 or less), total protein of 1.3 g/dL (2.5 g/dL or less), and ascites: serum LD ratio of 0.4 (less than 0.6) , are all suggestive of liver cirrhosis-related transudative ascites. In cases of prolonged severe disturbance of liver function, the albumin synthesizing capacity is lowered, and the serum colloid osmotic pressure is reduced, which makes the intravascular water easily migrate to the abdominal cavity. The elevated portal pressure is also a cause of ascites.

Visual differential counts

Nucleated cell count	726 /μL
Mononuclear cells	40 %
Lympho	11 %
Mono+Macrophages	29 %
Polymorphonuclear cells	59 %
Neutro	59 %
Eosino	0 %
Baso	0 %
Atypical lymphocytes	1 %

Other tests

Specific gravity	1.014
Total protein(g/dL)	1.3
Albumin(g/dL)	N.T.
A/G	N.T.
LD (U/L)	77
Sugar(mg/dL)	72

Knee arthritis (1)

Information from XN-Series

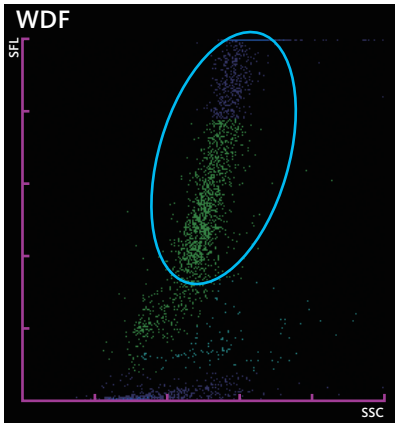
WBC-BF	0.160	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.148	10^9/L	92.5 %
PMN	0.012	10^9/L	7.5 %
TC-BF	0.234	10^9/L	

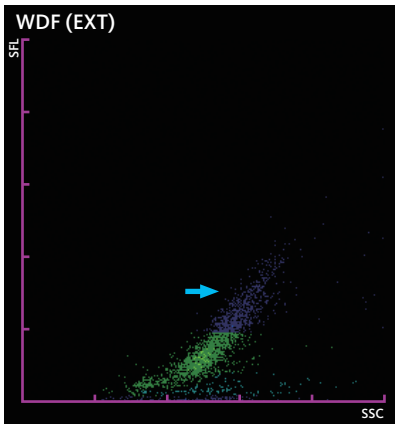
Research parameters

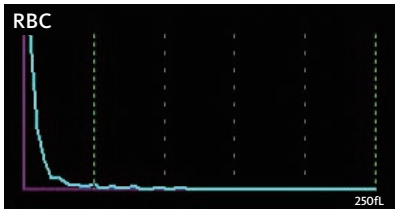
LY-BF	0.019	10^9/L	11.9 %
MO-BF	0.129	10^9/L	80.6 %
NE-BF	0.011	10^9/L	6.9 %
EO-BF	0.001	10^9/L	0.6 %
HF-BF	0.074	10^9/L	46.3 /100WBC
RBC-BF2	0.0003	10^{12}/L	

Flags

WBC Flag(s)







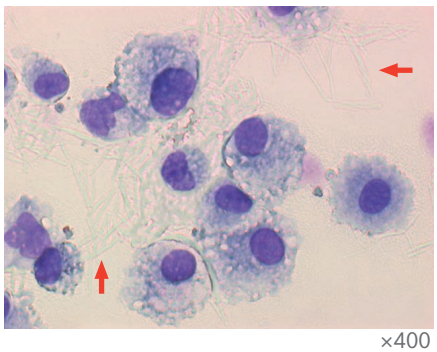
Point

In the WDF scattergram, a cluster is present in the mononuclear cell (MN) – high fluorescence (HF-BF) area. By comparison with the visual differential count, this seems to be a population of monocytes and macrophages (○). The WDF (EXT) scattergram also shows a cluster extending to the high fluorescence area (⬆). The synovial cells as well as macrophages seen in the cytospin smear, seem to be plotted in the high fluorescence area.

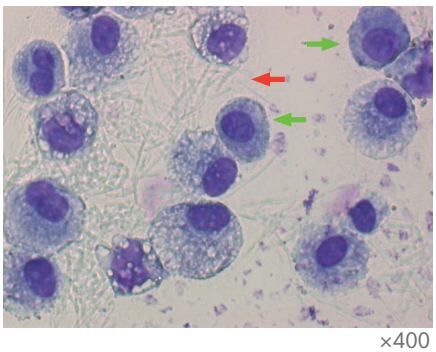
Case history

A 52-year-old male. He complained of swelling in the right knee joint. The synovial fluid was tested as gout was suspected.

Cytospin smear (May-Giemsa staining)



×400



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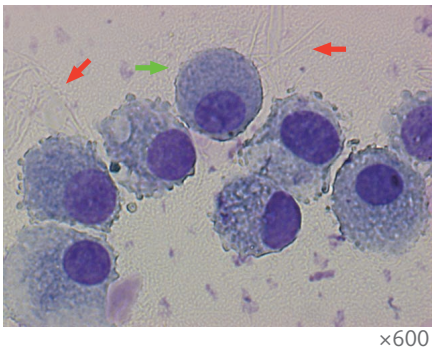


×600

Point

A large number of macrophages with foamy cytoplasm are seen. There are also a few synovial cells with a low N/C ratio. They have a basophilic thick cytoplasm and an eccentric nucleus (⬆). The transparent narrow-tipped, frayed strings are fibers of the fibrocartilage (⬆).

Visual differential counts

Nucleated cell count	300 /μL
Mononuclear cells	95 %
Lympho	1 %
Mono+Macrophages	94 %
Polymorphonuclear cells	0 %
Neutro	0 %
Eosino	0 %
Baso	0 %
Synovial cells	5 %

Knee arthritis (2)

Information from XN-Series

WBC-BF	45.644	10^9/L	*			
RBC-BF	0.019	10^{12}/L				
MN	4.909	10^9/L	*	10.8	%	*
PMN	40.735	10^9/L	*	89.2	%	*
TC-BF	45.666	10^9/L	*			

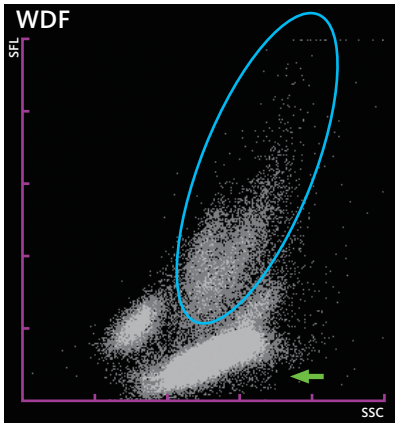
Research parameters

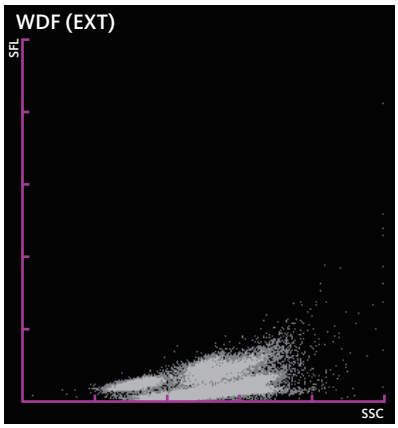
LY-BF	1.997	10^9/L	*	4.4	%	*
MO-BF	2.912	10^9/L	*	6.4	%	*
NE-BF	40.438	10^9/L	*	88.5	%	*
EO-BF	0.297	10^9/L	*	0.7	%	*
HF-BF	0.022	10^9/L	*	0.0	/100WBC	*
RBC-BF2	0.0191	10^{12}/L				

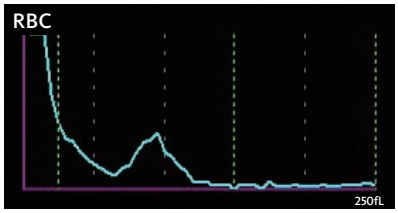
Flags

WBC Flag(s)

WBC Abn Scattergram







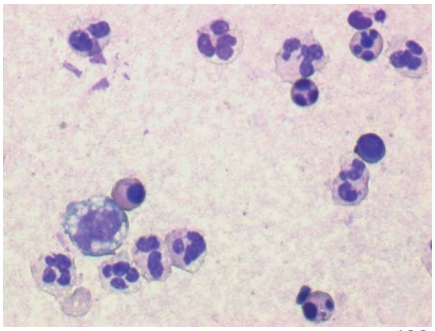
Point

There is a marked increase in the number of nucleated cells. The dominance of polymorphonuclear cells (neutrophils) indicates inflammation. The WDF scattergram has a cluster that is connected to the debris cluster (⬆). A large number of collapsed cells seem to have appeared in the debris area. As there is poor separation from the white blood cell cluster, the "WBC Abn Scattergram" flag is displayed. The macrophages phagocytosing neutrophils seen on the cytospin smear are considered to be plotted in the area of moderately strong fluorescence and side-scattered light (○).

Case history

A 48-year-old male. He came to the hospital with the complaint of swelling, feeling of heat and pain in the left knee joint.

Cytospin smear (May-Giemsa staining)



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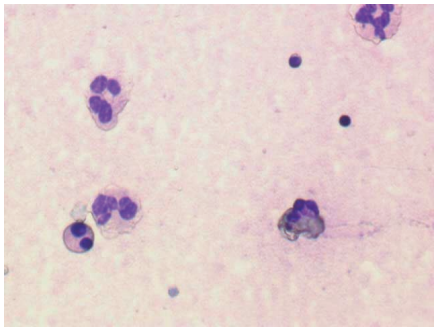

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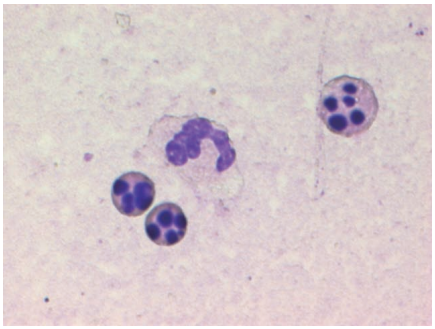

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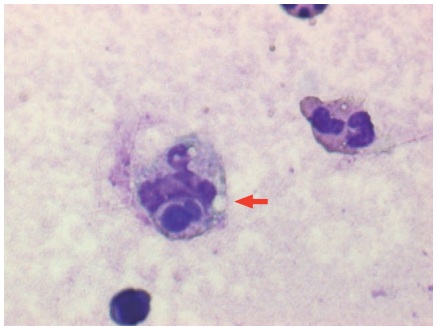


×600

Point

There is a marked increase in the number of nucleated cells on the cytospin smear. Most of them are neutrophils. Lymphocytes and macrophages are also seen, although with a smaller number. Some of the neutrophils have atrophic nuclei that are circular and dense. Small circular bodies considered to be their remnants are also present. There are macrophages phagocytosing neutrophils (⬆).

Visual differential counts

Nucleated cell count	46,180/μL
Mononuclear cells	13 %
Lympho	7 %
Mono+Macrophages	6 %
Polymorphonuclear cells	87 %
Neutro	87 %
Eosino	0 %
Baso	0 %

Pseudogout

Information from XN-Series

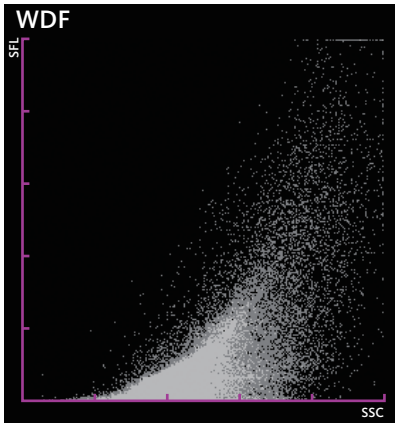
WBC-BF	5.170	10^9/L	*		
RBC-BF	0.316	10^{12}/L			
MN	0.658	10^9/L	*	12.7 %	*
PMN	4.512	10^9/L	*	87.3 %	*
TC-BF	5.238	10^9/L	*		

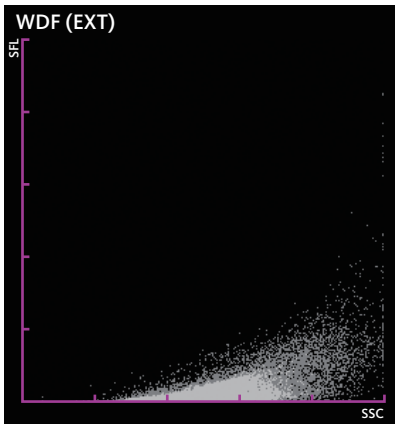
Research parameters

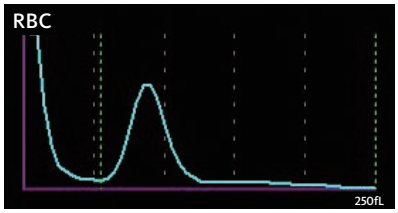
LY-BF	0.025	10^9/L	*	0.5 %	*
MO-BF	0.633	10^9/L	*	12.2 %	*
NE-BF	4.197	10^9/L	*	81.2 %	*
EO-BF	0.315	10^9/L	*	6.1 %	*
HF-BF	0.068	10^9/L	*	1.3 /100WBC	*
RBC-BF2	0.3162	10^{12}/L			

Flags

WBC Flag(s)
WBC Abn Scattergram







Visual differential counts

Nucleated cell count	47,280/μL
Mononuclear cells	8 %
Lympho	0 %
Mono+Macrophages	8 %
Polymorphonuclear cells	92 %
Neutro	92 %
Eosino	0 %
Baso	0 %

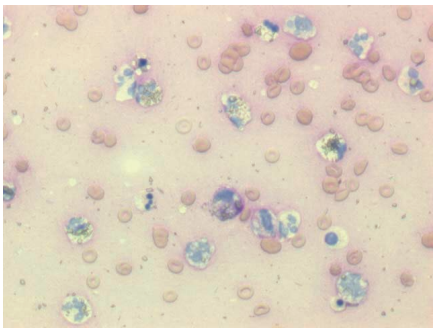
Point

In the WDF scattergram, most of the dots appear in the debris area and cluster separation is difficult. Apparently, the cells that have turned brittle are affected by the RBC lysing agent, and thus the nucleated cell count is less than in the visual differential count. The storage stability of body fluid samples varies with the type of sample, but generally the cells become brittle over time. It is therefore desirable to analyze body fluids as soon as possible after collecting.

Case history

A 36-year-old male. After surgery for primary hyperparathyroidism, the patient felt pain, swelling and a feeling of heat in joints of the right hand. As he had hyperuricemia, the synovial fluid was tested to confirm suspected gout or pseudogout.

Cytospin smear (May-Giemsa staining)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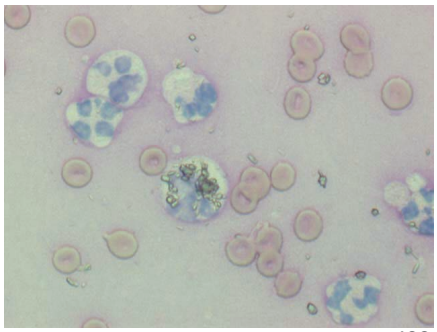
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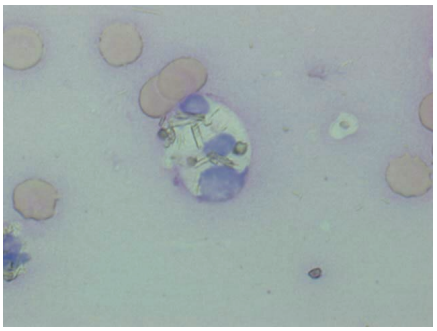
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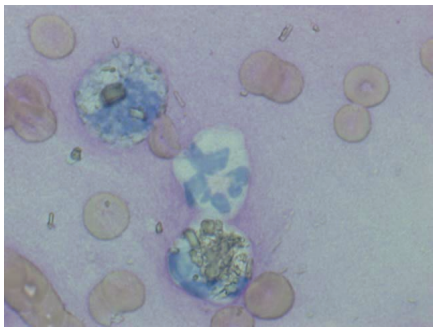

×600

Point

There is a marked increase in the count of nucleated cells on the cytospin smear. Most of them are neutrophils. There are a few macrophages as well. A large number of rod-shaped or rhomboid calcium pyrophosphate crystals are also seen, as well as neutrophils phagocytosing the crystals.

XN-Series

Other kinds of samples analyzed in the body fluid mode

Bacterial peritonitis

Information from XN-Series

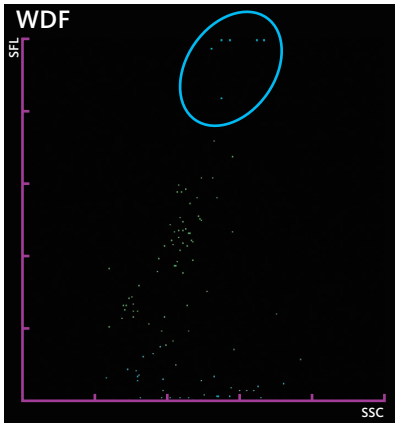
WBC-BF	0.006	10^9/L		
RBC-BF	0.000	10^{12}/L		
MN	0.006	10^9/L	100.0	%
PMN	0.000	10^9/L	0.0	%
TC-BF	0.007	10^9/L		

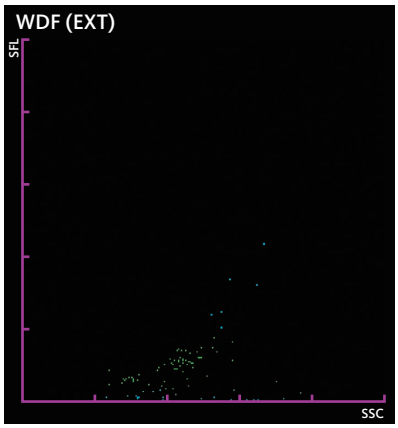
Research parameters

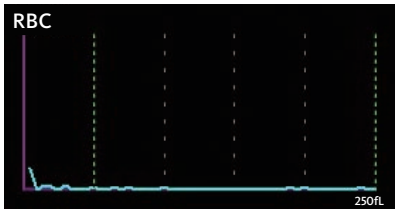
LY-BF	0.003	10^9/L	50.0	%
MO-BF	0.003	10^9/L	50.0	%
NE-BF	0.000	10^9/L	0.0	%
EO-BF	0.000	10^9/L	0.0	%
HF-BF	0.001	10^9/L	16.7	/100WBC
RBC-BF2	0.0001	10^{12}/L		

Flags

WBC Flag(s)







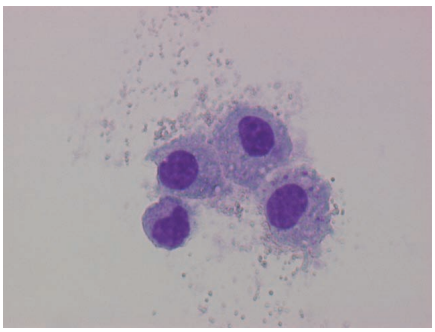
Point

There are a few nucleated cells; 100% of them are mononuclear cells. The mesothelial cells seen on the cytospin smear appear to be plotted in the high fluorescence (HF-BF) area of the WDF scattergram, which shows a small number of dots (○).

Case history

A 56-year-old female. She was under continuous ambulatory peritoneal dialysis (CAPD) for chronic renal failure. She repeatedly suffered from bacterial peritonitis. She was hospitalized for changing the catheter and treating the peritonitis. The CAPD fluid was analyzed.

Cytospin smear (May-Giemsa staining)



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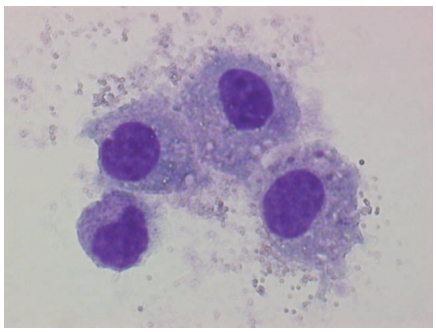

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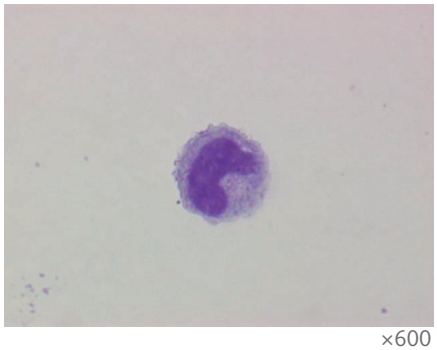


×600

Point

Macrophages with a purplish blue cytoplasm and vacuoles are seen. Because CAPD uses the peritoneal membrane, which comprises mesothelial cells, such cells in a variety of shapes are seen. They need to be distinguished from macrophages. The cells in this sample have a weakly basic cytoplasm, an eccentric nucleus and no perinuclear halos. As some of them are seen phagocytosing, they are considered to be macrophages.

Visual differential counts

Nucleated cell count	10	/μL
Mononuclear cells	97	%
Lympho	13	%
Macrophages	84	%
Polymorphonuclear cells	0	%
Neutro	0	%
Eosino	0	%
Baso	0	%
Mesothelial cells	15	%

Continuous ambulatory peritoneal dialysis (CAPD)-associated peritonitis

Information from XN-Series

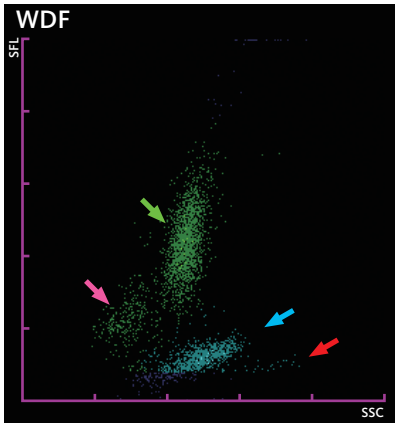
WBC-BF	0.285	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.197	10^9/L	69.1 %
PMN	0.088	10^9/L	30.9 %
TC-BF	0.288	10^9/L	

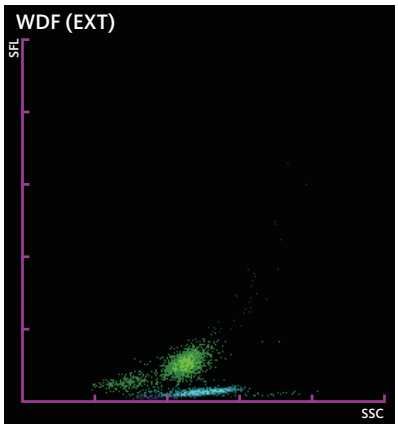
Research parameters

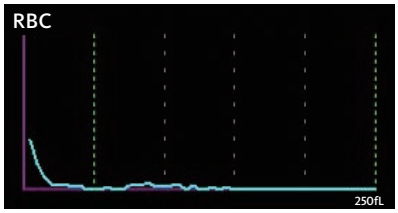
LY-BF	0.051	10^9/L	17.9 %
MO-BF	0.146	10^9/L	51.2 %
NE-BF	0.086	10^9/L	30.2 %
EO-BF	0.002	10^9/L	0.7 %
HF-BF	0.003	10^9/L	1.1 /100WBC
RBC-BF2	0.0003	10^{12}/L	

Flags

WBC Flag(s)







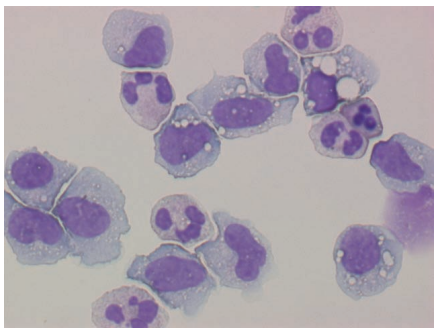
Point

The WDF scattergram shows clusters corresponding to lymphocytes (⬆), monocytes (⬆), neutrophils (⬆), and eosinophils (⬆). These cells appear in approximately the same areas of the scattergram as in peripheral blood analysis. With the XN analyzer, up to 4 differential white blood cell subpopulations can be reported as research parameters.

Case history

A 63-year-old male. The patient was on CAPD because of chronic renal failure. He visited the hospital because the CAPD fluid was turbid. CAPD fluid was analyzed because infection at the peritoneal catheter outlet or a CAPD-related peritonitis was suspected.

Cytospin smear (May-Giemsa staining)



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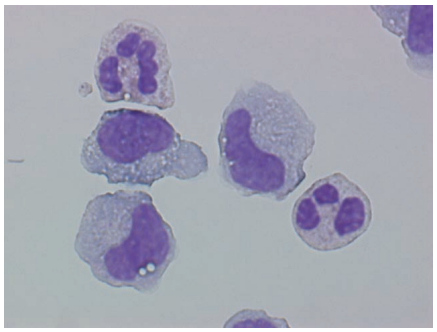

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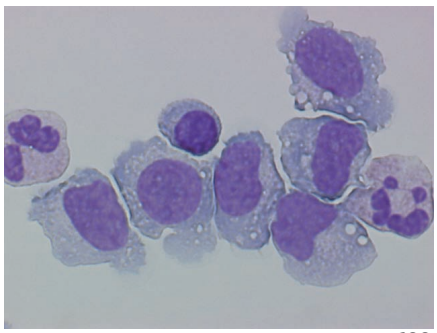


×600

Point

There is an increased number of nucleated cells on the cytospin smear. Most of them are neutrophils and monocytes. There are no phagocytosing or atypical cells.

Visual differential counts

Nucleated cell count	340 /μL
Mononuclear cells	67 %
Lympho	6 %
Mono	61 %
Polymorphonuclear cells	33 %
Neutro	33 %
Eosino	0 %
Baso	0 %

Interstitial pneumonia

Information from XN-Series

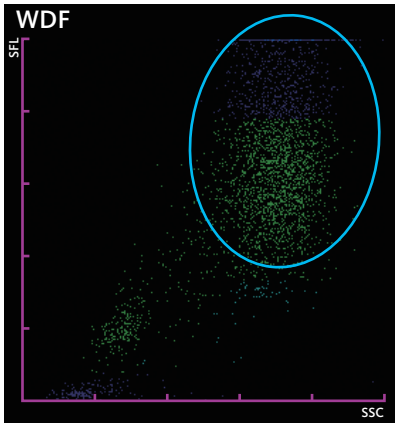
WBC-BF	0.199	10^9/L	
RBC-BF	0.000	10^{12}/L	
MN	0.194	10^9/L	97.5 %
PMN	0.005	10^9/L	2.5 %
TC-BF	0.274	10^9/L	

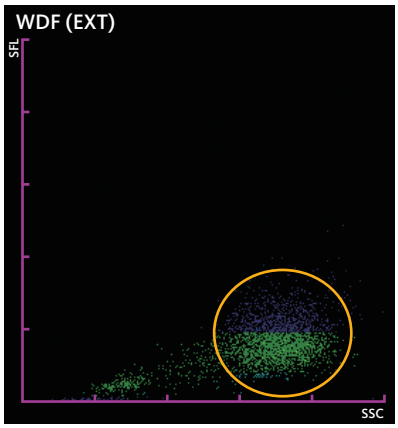
Research parameters

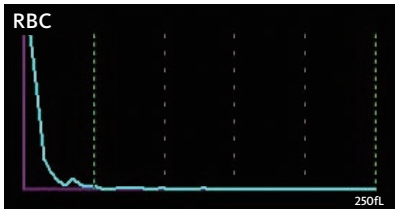
LY-BF	0.022	10^9/L	11.1 %
MO-BF	0.172	10^9/L	86.4 %
NE-BF	0.005	10^9/L	2.5 %
EO-BF	0.000	10^9/L	0.0 %
HF-BF	0.075	10^9/L	37.7 /100WBC
RBC-BF2	0.0003	10^{12}/L	

Flags

WBC Flag(s)







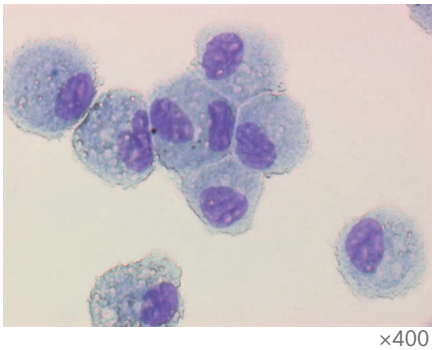
Point

This is a sample where the mononuclear cell population accounts for almost 100% of all cells. Comparison with the visual differential count indicates that the cluster (○) in the high fluorescence and high side-scattered light area in the WDF scattergram is that of macrophages. A cluster considered to consist of macrophages can be seen in the WDF (EXT) scattergram as well (○). The bronchoalveolar lavage fluid (BALF) contains macrophages in which the cytoplasm shows a networklike structure. Therefore, scattergram patterns of the type shown here are relatively frequent.

Case history

A 59-year-old female. BALF was analyzed to investigate her interstitial pneumonia in detail.

Cytospin smear (May-Giemsa staining)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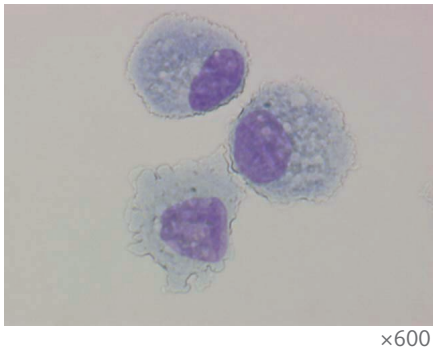
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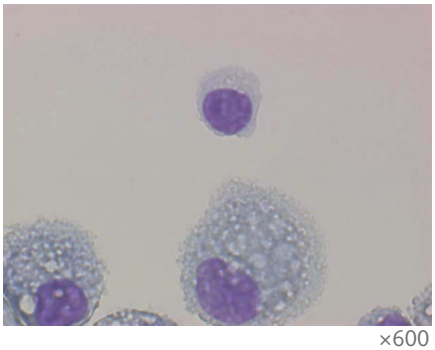
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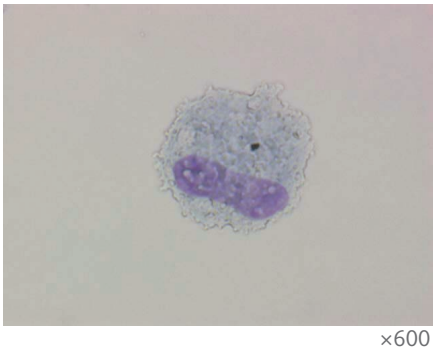

×600

Visual differential counts

Nucleated cell count	238 /μL
Mononuclear cells	100 %
Lympho	8 %
Macrophages	92 %
Polymorphonuclear cells	0 %
Neutro	0 %
Eosino	0 %
Baso	0 %

Point

The majority of the cells are macrophages. A small number of lymphocytes are also seen.

Chronic eosinophilic pneumonia

Information from XN-Series

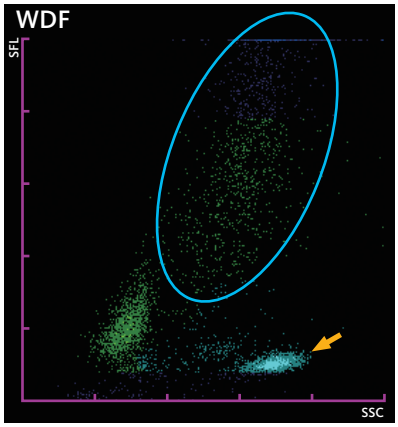
WBC-BF	0.373	10^9/L	
RBC-BF	0.001	10^{12}/L	
MN	0.202	10^9/L	54.2 %
PMN	0.171	10^9/L	45.8 %
TC-BF	0.436	10^9/L	

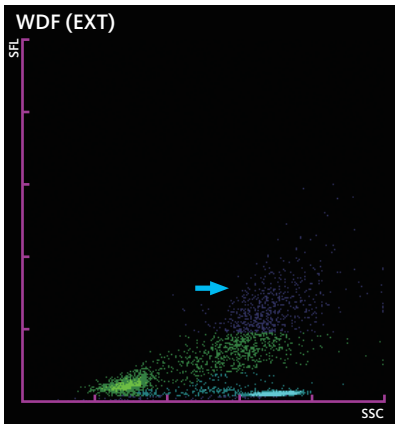
Research parameters

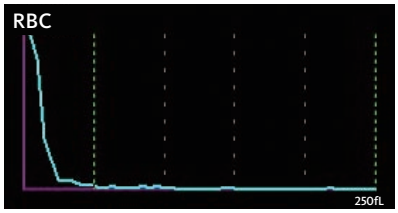
LY-BF	0.138	10^9/L	37.0 %
MO-BF	0.064	10^9/L	17.2 %
NE-BF	0.023	10^9/L	6.1 %
EO-BF	0.148	10^9/L	39.7 %
HF-BF	0.063	10^9/L	16.9 /100WBC
RBC-BF2	0.0006	10^{12}/L	

Flags

WBC Flag(s)







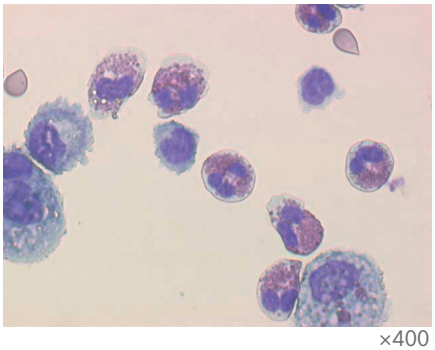
Point

The WDF scattergram shows a cluster (⬆) in the same area as eosinophils in the whole blood mode. The eosinophil fraction (EO-BF) research parameter is 39.7%, which agrees with the visual differential count. The macrophages seen on the smears are considered to be plotted in the mononuclear (MN) cell – high fluorescence (HF-BF) area (○). In the WDF (EXT) scattergram, more high fluorescence cells are plotted in a region above the HF-BF area (⬆). These are considered to be macrophages phagocytosing other cells.

Case history

A 48-year-old female. The patient had continuous fever and cough. Chronic eosinophilic pneumonia was suspected after reviewing chest X-ray images and laboratory findings. Therefore, BALF was analyzed for detailed investigation.

Cytospin smear (May-Giemsa staining)



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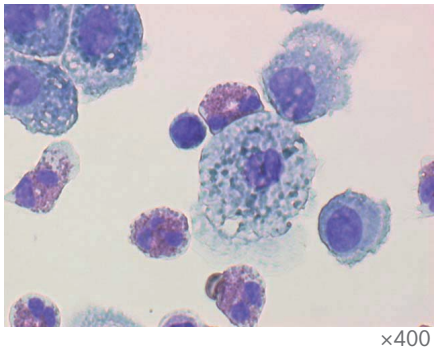

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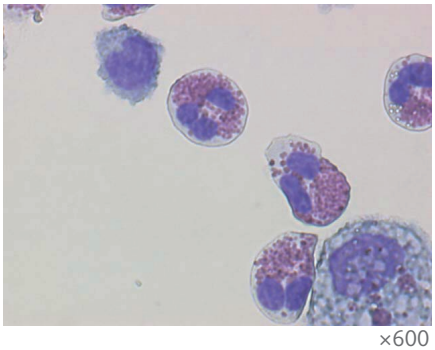

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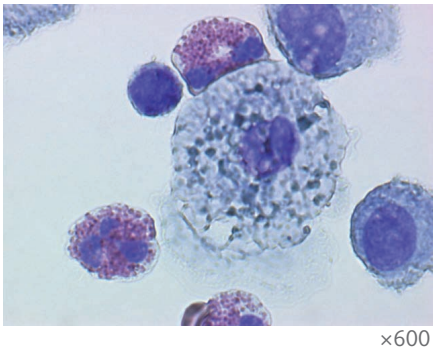

×600

Point

The number of eosinophils is high and there are also images of phagocytosing macrophages and lymphocytes.

Visual differential counts

Nucleated cell count	419 /μL
Mononuclear cells	59 %
Lympho	22 %
Macrophages	37 %
Polymorphonuclear cells	41 %
Neutro	3 %
Eosino	35 %
Baso	3 %

XN-Series