

BODY FLUID ROUTINE ANALYSIS AND AUTOMATION

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PONDICHERRY

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- Body fluids are one of the unique specimens received in the lab that require multidisciplinary testing.
 - The types of fluids most commonly examined are cerebrospinal (CSF), serous (pleural and peritoneal) and synovial.

Cerebrospinal fluid

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- Hematologic analysis of **CSF samples** should be performed within one hour of fluid aspiration. Both red blood cells (RBCs) and white blood cells (WBCs) have limited stability in **CSF** because **CSF** is hypotonic and cells can rapidly lyse

Indication for an analysis of CSF

- Inflammation
- Tumours
- Barrier dysfunctions
- Infection
- Bleeding
- Multiple sclerosis

Reference range for cell counts CSF

- WBC < 5/ μ L
- Lymphocytes or monocytes may normally occur
- No granulocytes
- No red blood cell

Appearance

Normal	Clear ,Colourless
Bacterial meningitis	Cloudy, Large clot
Viral meningitis	Clear, No clot
TB meningitis	Slightly cloudy ,Cob web appearance
Fungal meningitis	Clear
Tumors	Clear
Sub arachnoid H'ge	Xanthochromic



Normal	Total count	0-5 lymphocytes/cu.mm
Bacterial meningitis	1000-10000 /cu.mm	>500 neutrophils /cu.mm
Viral meningitis	<300 /cu.mm	10-200 lymphocytes /cu.mm
TB meningitis	50-500 /cu.mm	200 -500 lymphocytes/cu.mm
Fungal meningitis	20-500 /cu.mm	0-5 lymphocytes /cu.mm
Tumors		0-5 lymphocytes /cu.mm

Test	Appearance	Pressure	WBC/ μ L	Protein mg/dL	Glucose mg/dL	Chloride
Normal CSF	Clear	90 – 180 mm	0-8 lymph.	15-45	50-80	115-130 mEq/L
Acute bacterial meningitis	Turbid	Increased	1000 -10000	100 – 500	< 40	Decreased
Viral meningitis	Clear	Normal to moderate increase	5-300, rarely >1000	Normal to mild increased	Normal	Normal
Tubercular meningitis	Slightly opaque cobweb formation	Increased/ decreased, spinal block	100-600 mixed or lymph.	50-300 due to spinal block	Decreased	Decreased
Fungal meningitis	Clear	Increased	40-400 mixed	50-300	Decreased	Decreased

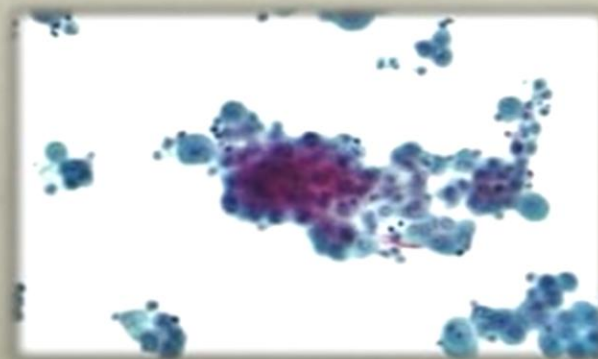
PLEURAL FLUID

The pleural cavity lies between these layers of mesothelium and contains physiologically a clear serous fluid of less than 15 mL.

A pleural effusion results from excessive accumulation of fluid in the pleural cavity.

Composition of pleural fluid

- Clear ultra filtrate of plasma
- Volume 0.3 mL/kg
- Cells/ mm³ 1000 – 5000
 - Mesothelial cells 60%
 - Monocytes 30%
 - Lymphocytes 5%
 - PMN's 5%
- Protein 1-2 g/dL
- LDH <50% plasma level(105-333IU/L)
- Glucose \cong plasma level(90-120)
- pH \geq plasma level(7.6-7.64)



PLEURAL EFFUSION

TRANSUDATE

- Congestive Heart Failure
- Liver cirrhosis
- Severe Hypoalbuminemia
- Nephrotic syndrome

EXUDATE

- Carcinomas
- Inflammation
- Trauma
- Pulmonary infarction
- Pulmonary embolism

ANALYSIS OF PLEURAL FLUID

Analysis	Remarks
Normal	< 1000 cells/ cu.mm
Transudate	< 1000 cells/ cu.mm
Exudate	> 50,000 cells/ cu.mm
Lymphocytosis	TB, Sarcoidosis ,Malignancy
Neutrophils Dominant	Empyema ,Pulmonary Embolism
Eosinophila	Pulmonary embolism, Benign Asbestosis, Malignancy
Haemorrhage	Non small cell carcinoma

CHARACTERISATION OF PLEURAL EFFUSION

CELLS	TRANSUDATE	EXUDATE
Total Cell Count	<1000 / μ l	\geq 1000 / μ l
Neutrophil	<250 / μ l	\geq 500 / μ l
RBC	<1000 / μ l	\geq 10000 / μ l

parameter	transudate	exudate
Total protein	<30 g/l	>30 g/l
Pleural-serum protein ratio	<0.5	>0.5
LDH	<200 u/l	>200 u/l
Pleural-serum LDH ratio	<0.6	>0.6
cholesterol	<45mg/dl	>45 mg/dl

PERITONEAL FLUID

NORMAL PERITONEUM

- Portal hypertension
- Congestive Heart failure
- Fulminant hepatic failure
- Budd –Chiari syndrome
- Nephrotic syndrome
- Severe malnutrition

DISEASED PERITONEUM

- Tuberculosis peritonitis
- Bacterial peritonitis
- Peritoneum carcinomatosis
- Primary Mesothelioma
- Pseudomyxoma Peritonei
- Vasculitis

ANALYSIS

APPEARANCE	CONDITION
Transparent	Normal
Straw coloured	Cirrhosis
Haemorrhagic	Malignancy
Cloudy	Infection
Chylous	Lymphatic obstruction
Bile stained	Biliary contamination

CELL COUNT ANALYSIS

TOTAL CELL COUNT	MORPHOLOGY	CONDITION
< 500 WBC	Neutrophil <250/cu.mm	Normal
>500 WBC	Neutrophil >250/cu.mm	Bacterial peritonitis
>500 WBC	Lymphocyte +++++	TB, Malignancy

	Levels	Interpretation
<ul style="list-style-type: none"> • Triglyceride 	<ul style="list-style-type: none"> • Elevated 	<ul style="list-style-type: none"> • Malignant tumour, lymphoma, TB • Parasitic infection, hepatic cirrhosis
<ul style="list-style-type: none"> • Protein 	<ul style="list-style-type: none"> • 0.3-4.0g/dL • >4g/dL 	<ul style="list-style-type: none"> • Normal • TB, SBP
<ul style="list-style-type: none"> • Glucose 	<ul style="list-style-type: none"> • 7-10 • <6 	<ul style="list-style-type: none"> • Normal • TB and malignancy
<ul style="list-style-type: none"> • Amylase 	<ul style="list-style-type: none"> • 50% of serum level • Increased (Up to 5x serum level) 	<ul style="list-style-type: none"> • Normal • Pancreatitis, pancreatic pseudocyst, pancreatic trauma or Intestinal strangulation
<ul style="list-style-type: none"> • Alkaline phosphatase 	<ul style="list-style-type: none"> • Increased 	<ul style="list-style-type: none"> • Small bowel perforation and strangulation

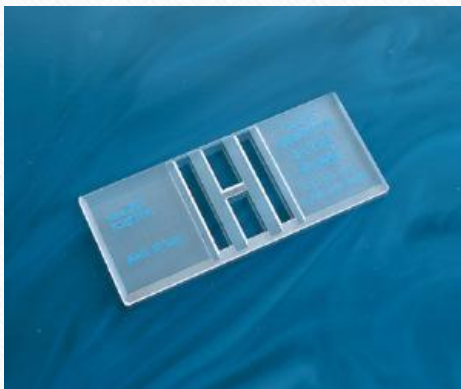
SYNOVIAL FLUID

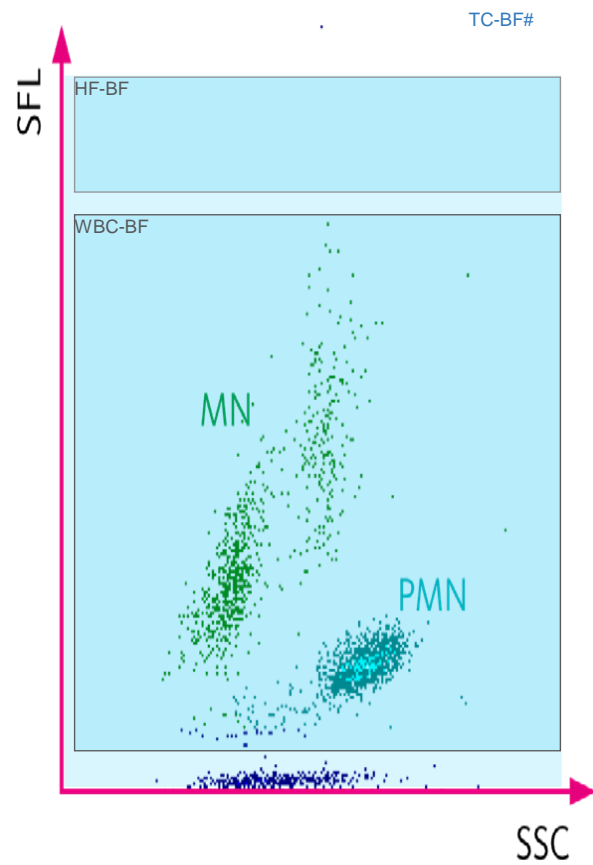
- Sodium heparin is recommended as anticoagulant .
- If the viscosity is very high, a dilution with saline or adding hyaluronidase to the specimen (400 units to 1 mL synovial fluid, then incubate for 10 minutes at 37°C) .
- WBC < 200/ μ L, PMN < 25%, and no red blood cells

CONDITION	WBC[x10 ⁶ /L]	NEUTROPHIL
NON INFLAMMATORY	< 2000	<25%
INFLAMMATORY	2000-50,000	>50%
SEPTIC	>50,000	>75%

AMERICAN RHEUMATIC ASSOCIATION RECOMMENDATION

Haematology analysers





TC-BF# = total count of nucleated cells in body fluids

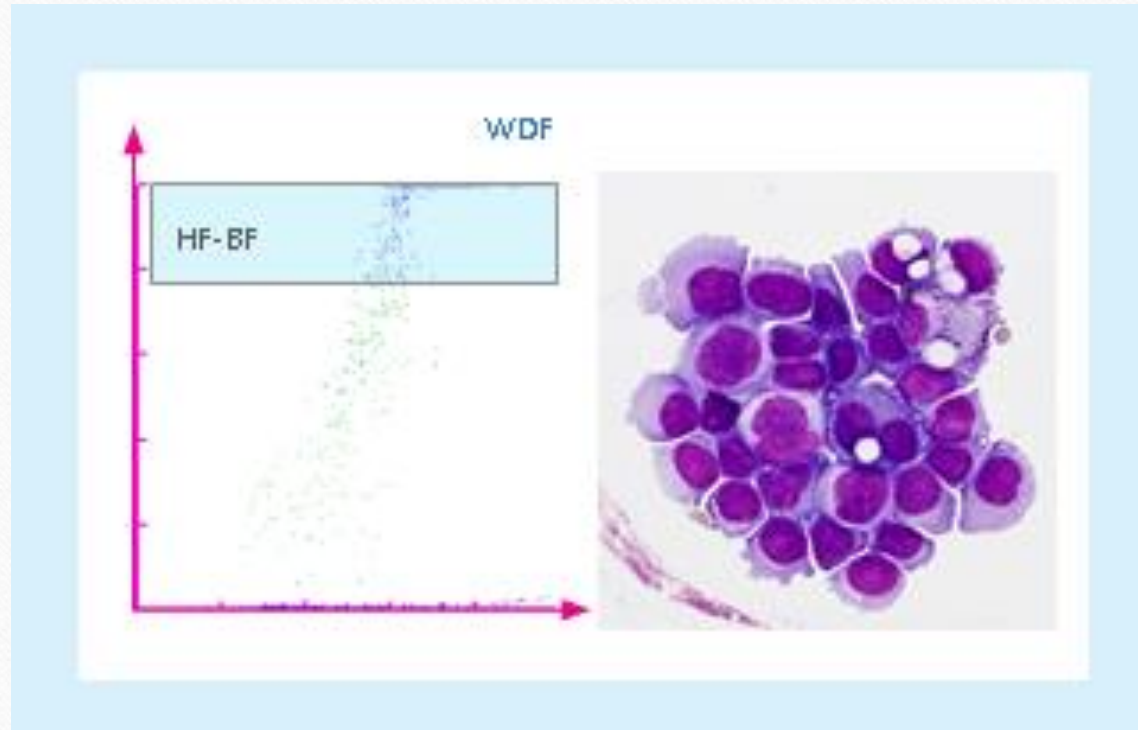
WBC-BF = white blood cell count in body fluids

RBC-BF = red blood cell count in body fluids

PMN = polymorphonuclear cells

MN = mononuclear cells

HF-BF = cells in the high-fluorescence area



The WBC differential of the analyser is always related to the WBC-BF count.

In case the TC-BF# is selected for reporting in the *Extended* IPU, it also calculates PMN and MN, including the research parameters (e.g. HF-BF, EO-BF, NE-BF, LY-BF, MO-BF), on the basis of TC-BF#.

BENEFITS

- **Reduced TAT**

- **No Sample Preparation**
- **Small Sample Volume**
- **Low Limit Of Detection**
- **2-part WBC Differential (PMN And MN)**
- **Research 4-part WBC Differential**
- **One Flag To Notify Abnormalities**
- **QC Material Commercially Available**

LIMITATIONS

In detecting reactive and malignant cells

No EQAS available

Recommendations :

Critically review scattergrams and histograms to detect abnormalities and follow up with manual method.

URINALYSIS ANALYSERS IN BODY FLUID MODE

BENEFITS

- BF mode always on board (WBC, RBC, EC, TNC, BACT)
- 2-part WBC differential (PMN and MN)
- Low limits of detection for WBC, RBC and bacteria
- No sample preparation

DEMERITS

Requires large volume

In detecting reactive and malignant cells

How to start ?

- **Access the background count on the instrument.** Since normal cell counts on body fluids are very low, it is imperative to have a low, preferably 0.00 background.

0.00–indicates 5 or fewer particles present

0.01–indicates 6-15 particles

0.0 –indicates approximately 50 or fewer particles

0.1–indicates anywhere from 50-150 particles

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- Analyze the instrument-generated histogram and/or scattergram on all body fluid samples. The same rules used for the acceptability of results for peripheral blood also apply to body fluids.
 - Perform precision studies especially in the low ranges.
 - Perform correlation studies on all types of fluids.

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- Automated differentials have limited accuracy on most body fluid samples.
 - Increased fragility and rapid degeneration of cells suspended in various body fluids.
 - Neutrophils, which can rapidly blend with other cell populations on current hematology instrumentation

ICSH GUIDELINES FOR AUTOMATED CELL COUNTERS

- **SPECIMEN HANDLING:**

Collection	Sample stability
Type of container	Cellular deterioration
Transportation	Cell lysis
Storage	Bacterial growth <ul style="list-style-type: none">• Pretreatment

Performance

- Precision
- Accuracy
- Analytical sensitivity
- Specificity
- Reference range
- Linearity
- Patient correlation



- Background check for CSF

< LOB -Repeat LOB, cleaning cycle

- Flag sign

Spurious results, cell debris, cell clumps

Do manual or wet preparation

- Expressed units

Same units as CBC

QUALITY CONTROL

INTERNAL QUALITY CONTROL

- Commercial control [CBC]
- Specific body fluid mode[separate control]
- Proficiency Testing -Blind testing
- Inter Laboratory Control

EQAS

- **Quality Management Proficiency Laboratory Service of Ontario**

College of American Pathologist

UK –NEQAS

JSLH



Automated measurement of body fluids and appropriate technical validation of the counts help to improve result quality and their time to report.

Thank you

