Improving patient care through laboratory testing

November 2010, Issue 5

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Metro’s New Hematology Instruments

- Immature Granulocytes (IG%, #)
- Reticulocyte Hemoglobin (RET-Hb)
- Reticulocyte Profile
- Mean Platelet Volume
- Immature Platelet Fraction (IPF)
- Nucleated RBCs
- Fragmented RBC (Schistocytes)

This Month’s Featured Patient Service Center
In 2010, to serve you better, Metro Lab upgraded the hematology instrumentation at each of our hospital campuses, plus Metro Central Moline, with Sysmex XE-5000 analyzers. Automated hematology analyzers have become increasingly sophisticated and generate many clinically useful parameters. These include:

- Immature granulocytes (IG)
- Immature platelet fraction (IPF)
- Reticulocyte hemoglobin (RET-Hb)
- Immature reticulocyte fraction (IRF) – see page 5
- Nucleated red blood cells (NRBC)
- Schistocytes or Fragmented red blood cells (FRBC)

The following pages describe the uses of these new additions to our hematology offerings.

### Hematology Parameters and Their Clinical Utility

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<td>Schistocytes (RBC fragments) (FRBC)</td>
<td>Diagnosis and monitoring of microangiopathies.</td>
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THE NEW 6-PART DIFFERENTIAL

Usually immature granulocytes are classified on the basis of cell morphology by the microscopic exam of a stained blood film. However, the manual differential count is imprecise because of the small number of cells counted and inter-observer variability. Our new hematology analyzers (Sysmex XE-5000) give a 6-part leukocyte differential which includes a quantification, collectively, of the immature granulocytes (metamyelocytes, myelocytes, and promyelocytes) and reported (example shown) at the end of the CBC as IG% and IG#.

All IG% quantitations, 1% or over, are flagged for manual review. The presence of IG above 2% can be significant whether or not anything abnormal is detected in the manual review, because the automated instrument has screened thousands of cells in contrast to 100 cells reviewed manually.

CLINICAL RELEVANCE:

The Immature Granulocyte can be an Aid in Predicting Bacteremia and or Sepsis especially if IG% is >2%.

Graph Comparison of The Immature Granulocyte Fraction (blue) vs WBC Count (Red)

NOTE: The IG % correlates better with infection and positive blood culture than the WBC count in this study1.

1 From Depart of Pathology, the Johns Hopkins Medical Institutions. Am J Clin Pathol 2003; 120:795-800.
Reticulocytes are the most immature RBCs in the normal peripheral circulation. The RET-Hb determines the amount of hemoglobin in reticulocytes and gives a “snapshot” of the iron directly available for hemoglobin synthesis. This measurement is an early indicator of the body’s iron status before indicated by a decrease in the standard Hemoglobin test.

**CLINICAL RELEVANCE:**
This determination of the reticulocyte hemoglobin content (RET-Hb) provides an early measure of functional iron deficiency:

**END STAGE RENAL DISEASE (ESRD)**
The RET-Hb is an established parameter in the National Kidney Foundation’s Quality Initiative Guidelines for assessing the initial iron status of patients with chronic kidney disease on hemodialysis, as well as for IV iron replacement in these patients.

- Reduction of this fraction indicates iron-deficient erythropoiesis, even in conditions in which traditional biochemical markers such as ferritin and transferrin are inadequate, e.g. In cases of inflammation or anemia from chronic disease.
- Useful for monitoring early response to intravenous iron therapy because RET-Hb increases significantly after only 48 hours.
- Low values are indicative of iron-deficient erythropoiesis in patients undergoing dialysis and even in functional deficits, which appear in patients treated with erythropoietin.
- RET-Hb of <28 pg accurately predicts functional anemia when compared with Ferritin and Transferrin saturation. Mean Value for both adult men and women is 30.8 pg.

**PEDIATRICS**
RET-HB is considered the most reliable index of iron deficit and iron-deficiency anemia, even in pediatric populations. (JAMA 2005;294:924-930).
Test can be predictive – identifying iron deficiency before absolute anemia develops. This is especially important in the neonate.

Dr. C. Ulruch at Children’s Hospital in Boston states:

“In neonates this is especially important since there is mounting evidence that iron deficiency in infants can cause permanent neurocognitive deficits – even before progressing to the point of anemia.”

A value less than 26 pg is an early indicator of iron restricted hematopoiesis and iron deficiency anemia. Values for infants and toddlers are lower than the adult range of 24.1-35.8 pg.
THE RETICULOCYTE PROFILE

The Reticulocyte Hemoglobin (RET-Hb)  
The Reticulocyte count  
The Immature Reticulocyte Fraction (IRF)

Use of Reticulocyte Profile in Iron Deficiency Anemia Diagnosis

<table>
<thead>
<tr>
<th>Reticulocyte Count</th>
<th>Reticulocyte Hemoglobin (RET-Hb)</th>
<th>Immature Reticulocyte Fraction</th>
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<tbody>
<tr>
<td>Normal/Low</td>
<td>Low</td>
<td>Low</td>
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</table>

- **THE RETICULOCYTE HEMOGLOBIN (RET-Hb)**

  The RET-Hb level indicates actual red blood cell Hb content in reticulocytes. Measures adequacy of iron availability, and gives an early/direct identification of iron deficient erythropoiesis.

- **RETICULOCYTE COUNT**

  Necessary, important adjunct to the RET-Hb measurement. The reticulocyte count indicates the adequacy of red blood cell production in response to erythropoietin.

- **THE IMMATURE RETICULOCYTE FRACTION (IRF)**

  The stored retics released into the peripheral blood during the first 24 hours in response to stress, represent the most timely indicator of a marrow’s erythropoietic activity.
  
  These early released “Immature retics” are expressed in a ratio:
  \[
  \frac{\text{Immature Reticulocytes}}{\text{Total Reticulocytes}} = \text{The Immature Reticulocyte Fraction}
  \]

  The IRF increase may precede a measurable increase in the absolute reticulocyte count.

  Nephrologists and hematologist-oncologists especially may find the IRF useful since their patients are the most likely to be recovering from bone marrow suppression or receiving erythropoietin, clinical circumstances in which the IRF has predictive value for hematologic recovery.

  **Immatue Reticulocyte Fraction (IRF)**

  **Clinical Utility in Medical Practice**

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<th>Evaluate Normochromic Anemias of Various Etiologies</th>
<th>Monitor Anemia Therapy</th>
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<td>Classification of Anemias</td>
<td>Monitor EPO Therapy in Renal Failure, AIDS, Infants, MDS</td>
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<tr>
<td>Detection of Occult or Compensated Hemorrhage</td>
<td>Monitor Effects of Toxic Drugs on Marrow</td>
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<td>Detection of Aplastic Crisis in Hemolytic Anemias</td>
<td>Monitoring of Aplastic Anemia</td>
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The IMMATURE PLATELET FRACTION (IPF)

The IPF is: a DIRECT measure of immature platelet production, indicates the Rate of platelet production, and is an index of thrombopoietic activity.

Evaluation of Patients with Low Platelets

<table>
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<tr>
<th>Increased IPF</th>
<th>Indicative of peripheral platelet destruction (e.g. ITP, TTP, or DIC)</th>
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<tbody>
<tr>
<td>Normal/Decreased IPF</td>
<td>Suggestive of decreased platelet production (e.g. Drug induced marrow suppression or aplastic anemia)</td>
</tr>
</tbody>
</table>

IPF Adult Reference Range: 1.1 – 7.1% \(^1\)

CLINICAL RELEVANCE:

Evaluation of Thrombocytopenia
IPF distinguishes between:

- Decreased production of platelets in bone marrow and
- Peripheral destruction (consumption) of platelets.

Until now we have had only the “traditional platelet count” as a parameter capable of assessing and monitoring thrombopoietic activity. Now with our new fluorescent flow cytometric capacity, Metro provides you with better resources for diagnosis.

Evaluation of Prophylactic Transfusion Use
Useful for determining transfusion need by better predicting the timing of platelet recovery after chemotherapy.

Evaluation of Patient Response to Chemotherapy
Provides faster determination of response to changes in therapy.

Assessment of Acute Coronary Syndrome Patient
IPF considered by some as an independent risk factor for myocardial infarction in patients with coronary disease.

\(^1\)St. Luke’s Hospital – Kansas City, Mo. (Regional Ref Lab for IPF)
MEAN PLATELET VOLUME (MPV)

A quantitative measurement of the average size of platelets found in blood. Since the average platelet size is larger when the body is producing increased numbers of platelets, MPV results can be used to make inferences about the production of platelets in bone marrow.

CLINICAL RELEVANCE:

Thrombocytopenia

An aid in differential diagnosis of acquired thrombocytopenia can distinguish forms with:

<table>
<thead>
<tr>
<th>Increased MPV</th>
<th>Peripheral origin with increased platelet production and normal megakaryocyte function: (immunologic thrombocytopenic purpura and DIC)</th>
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<tbody>
<tr>
<td>Normal / Decreased MPV</td>
<td>Have defect in platelet production (acute leukemia, bone marrow aplasia and chemotherapy or radiation therapy)</td>
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</tbody>
</table>

Cardiovascular Risk Factor

Considered by some as an independent risk factor for myocardial infarction in patients with coronary disease, and for death or recurrent vascular events after an acute MI (because MPV is a known marker for platelet activation).  

NUCLEATED RED BLOOD CELLS (NRBC)

Nucleated Red Blood Cells are precursor red blood cells, usually found only in the bone marrow, but now found in peripheral blood...

CLINICAL RELEVANCE:

- Presence of NRBC is always abnormal (except in immediate neonatal period).
- The number of NRBC correlates with severity of prognosis.
- Indicates extreme increase in erythropoietic activity.
- Can be result of damage to the bone marrow environment e.g. leukemia, cancer, myelofibrosis, etc.

SCHISTOCYTES (FRAGMENTED RED CELLS) FRBCs

Schistocytes are circulating, fragmented rbcrs resulting from mechanical damage due to:

- Cardiovascular disorders (e.g. prosthetic valve, endocarditis).
- Microangiopathies (e.g. thrombotic thrombocytopenic purpura, hemolytic-uremic syndrome, DIC).
- Immune disorders and
- Severe infection
- Following stem cell transplantation.

CLINICAL RELEVANCE:

Diagnoses of microangiopathies are of extreme importance as they are often life threatening diseases and identification/quantification of FRBCs is an important diagnostic criterion.

This month’s featured Patient Service Center:

Metropolitan Medical Laboratory, PLC
1520 7th Street, Moline, IL 61265

Outpatient Hours:
Monday – Friday 6:00 a.m. to 6:00 p.m.
Saturday 6:00 a.m. to 12 Noon

Metropolitan Medical Laboratory, PLC
Other Convenient Locations

Davenport Main Campus
1828 E. Locust, Davenport, IA 52803

Trinity Moline
500 John Deere Road, Moline, IL 61265

Trinity Rock Island
2701 17th Street, Rock Island, IL 61201

John Deere Family Center
4101 John Deere Road, Moline, IL 61265

Trinity Bettendorf
4500 Utica Ridge Road, Bettendorf, IA 52722

Genesis East Campus
1227 E. Rusholme, Davenport, IA 52803

Genesis West Campus
1401 W. Central Park, Davenport, IA 52804

Genesis Convenient Care East
4017 Devils Glen Road, Bettendorf, IA 52722

Genesis Convenient Care North
1520 W. 53rd Street, #2, Davenport, IA 52808

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Patient Service Center Coming Soon:

SILVIS

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