|  |  |
| --- | --- |
| **Prepared by:** | Nancy J. Konopka, MS, MT(ASCP) |
| **Supervisor Approval:** | Tracy S. McCartney MT(ASCP) – Signature on file |
| **Administrative Director Approval:** |  |
| **Medical Director Approval:** | **I have reviewed this document and approve it for use.** |
| Dr. Cindy Sturtz – Signature on file |

**PURPOSE:**

This procedure provides instructions for calculating the following CBC indices and supplemental parameters:

* Hematocrit
* MCV,
* MCH,
* MCHC,
* Absolute Neutrophil Count (ANC) and
* Immature to Total Neutrophil Ratio (I/T Ratio).

**PRINCIPLE:**

The **hematocrit** is the packed red blood cell volume denoting the percentage of erythrocytes in a known volume of whole blood.

The **MCV** (mean cell volume) is the average erythrocyte size in a sample of whole blood.

The **MCH** (mean cell hemoglobin) denotes the average weight of erythrocyte hemoglobin in a sample of whole blood.

The **MCHC** (mean cell hemoglobin concentration) denotes the average concentration of hemoglobin in in grams/dL of erythrocytes.

The **absolute neutrophil count (ANC)** is a measure of the number of segmented neutrophils and bands present in the blood. It is typically expressed in the same units as the total WBC count. The rationale for excluding promyelocytes, myelocytes, and metamyelocytes from the ANC is that they lack the immunological function of band and segmented neutrophils in the clinical setting of infection (Clement, P. and Patel, J., 10/17/2015).

An elevated ANCrepresents *absolute neutrophilia,* typically an indicator of an inflammatory response or systemic infection. A decreased ANC represents a*bsolute neutropenia* which strongly correlates with increased susceptibility to infection. Certain clinical conditions can contribute to neutropenia as can treatments including as chemotherapy, radiation, or marrow transplants. Following such treatments, a subsequent rise in the ANC reflects bone marrow recovery.

**The immature to total granulocyte ratio (I/T ratio)** compares the percentage of immature granulocytes (bands, metamyelocytes and myelocytes) to total granulocytes (NNF Teaching Aide, web access 9/7/2016). A high I/T ratio indicates that immature neutrophils were released from the bone marrow in response to an infectious process.

In pediatric practice, some investigators have shown that a low WBC count, a low ANC and a high I/T ratio are predictors of infection during childhood. Additionally, these parameters may provide information about the newborn’s risk of early-onset sepsis.

## PROCEDURE:

**Calculating the absolute neutrophil count (ANC)**

ANC = WBC X (% neutrophils + % bands) / 100

*Example:*

*WBC = 8.0 WBCs X 103/mm3*

*% Segmented neutrophils = 42*

*% Bands = 8*

*ANC = 8 X (42 + 8) / 100 =* ***4 X 103****WBCs/mm3*

***OR***

*WBC = 8000/mm3*

*ANC = 8000 X (42 + 3) / 100 =* ***4000*** *WBCs/mm3*

**Calculating the immature to total granulocyte ratio** **(I/T ratio)**

**Step 1:** Calculate the total percentage of immature neutrophils (exclude promyelocytes and blasts).

***%*** *Immature neutrophils = % bands + % metamyelocytes + % myelocyte*

**Step 2:** Calculate the I/T ratio

*I/T =* ***%*** *Immature neutrophils / (% immature neutrophils + % segmented neutrophils*

*Example:*

*% Segmented neutrophils = 50*

*% Bands = 20*

*% metamyelocytes = 6*

*% myelocytes = 4*

*Immature granulocytes = 20 + 6 + 4 = 30*

*I/T = 30 / (30 + 50) = 0.38*

**LIMITATIONS:**

Because units of measurement for WBCs and ANCs vary by institution, the same ANC count can be expressed in several ways. For example, an ANC report of *5.2 X 103 ANCs/mm3*could also be reported as *5,200 ANCs/mm3*.

When verbally reporting an ANC results, staff should avoid any misunderstanding by include the units of measurement with the ANC. At this institution, the ANC is expressed as n X 103 ANCs/mm3, where

n represents the number of neutrophils X 103 found in 1 mm3 of blood.

**EXPECTED VALUES:**

**RBC parameters**

Adult ranges (18+ years) are given.For other age groups, refer to the HEM 5000,

Hematology Reference Ranges.

* **Hematocrit-** males: 36.7 – 51.3 %; females: 34 – 45.8 %
* **MCV-** 82.7 – 97.3 fL
* **MCH-**27 - 33 pg
* **MCHC-** 23 -36 g/dL

**Absolute neutrophil count (ANC)**

Adult reference range: 1.5 to 8.0 X 103 neutrophils/mm3 or 1,500 to 8,000 neutrophils/mm3

For reference ranges for other age groups, refer to the total WBC count reference ranges in HEM 5000, Hematology Reference Ranges and perform appropriate calculations.

**Immature to total granulocyte ratio (I/T Ratio)**

Reference range: < 0.25

Clinical studies indicate that values > 0.300 x 103 / ul or >3% IGs correlate with serious infections and sepsis in some populations.

**REFERENCES:**

* Clement, P. and Patel, J., CAP Today, <http://www.captodayonline.com/qa-column-1015/>

10/17/2015.

* McKenzie, Shirlyn. Clinical Laboratory Hematology. Pearson-Prentice Hall. Upper Saddle River, NJ. 2004.
* NNF Teaching Aids, via <http://newbornwhocc.org/pdf/teaching-aids/neonatalsepsis.pdf>; last web access: 9/07/2016.
* aDepartments of Epidemiology and Biostatistics and Pediatrics, School of Medicine, University of California, San Francisco
* bDivision of Research, Kaiser Permanente Northern California, Oakland, California
* cDepartment of Applied Mathematics and Statistics, University of California, Santa Cruz, California
* dDivision of Newborn Medicine, Children’s Hospital, Boston, MA
* eHarvard Medical School, Boston, MA
* fDepartment of Newborn Medicine and Channing Laboratory, Brigham & Women’s Hospital, Boston, MA
* gDepartment of Inpatient Pediatrics, Kaiser Permanente Medical Center, Walnut Creek, California
* **Address correspondence to:** Thomas B. Newman, MD, MPH, Department of Epidemiology & Biostatistics, UCSF Box 0560, San Francisco, CA 94143. (Voice: 415-514-8007; Fax: 415-514-8150; Email:
* Zwick, David. Revised Leukocyte Differential Reports: combined metamyelocytes, myelocytes and promyelocytes as one parameter- “Immature Granulocytes” and role of automation. Pathology and Laboratory Medicine Newsletter, Children’s Mercy Hospitals and Clinics. June 2007.

[ude.fscu.ipe@namwen](mailto:dev@null)). Reprints not available.

**Document History**

|  |  |  |
| --- | --- | --- |
| Date of Origination and Document Control Number | 5/31/2017  HEM 5700.0 P | Nancy J. Konopka MT (ASCP) |
| Revision History/ Biannual Review: |  |  |
| Revision History/ Biannual Review: |  |  |
| Revision History/ Biannual Review: |  |  |
| Revision History/ Biannual Review: |  |  |
| Revision History/ Biannual Review: |  |  |