ALQEP

ALBERTA LABORATORY QUALITY ENHANCEMENT PROGRAM

College of Physicians and Surgeons of Alberta

A Laboratory Approach to the Investigation of Anemia

An Educational Supplement prepared by ALQEP – December 2009

Anemia can be defined as any condition in which the number of red blood cells, the amount of hemoglobin, or the volume of packed red blood cells in the blood are lower than normal levels.

Clinically this is important when it contributes to decreased oxygen-carrying capacity and decreased oxygen delivery to tissues. If cardiac, pulmonary or vascular disease is also present, the number of available red cells to carry oxygen is even more important.

A reduction in red cells or hemoglobin concentration can be broadly thought of as arising in one of three ways:

- Decreased production of red cells—such as pure red cell aplasia or aplastic anemia;
- Abnormal maturation or function of early erythroid precursors—such as may be seen in myelodysplastic syndromes;
- Increased loss or destruction of red blood cells—through bleeding or hemolysis.

Just as there are many causes of anemia, there are many classification schemes. From a laboratory perspective, classification according to the size or shape of red cells is common (microcytic vs. macrocytic or spherocytic vs. non spherocytic). Classification according to cause of anemia such as hemolytic anemia or nutritional anemia is also possible. Upon first assessment of a new anemia in a patient the most useful classification scheme for guiding additional diagnostic investigations is to classify according to whether or not polychromasia and/or reticulocytes are increased. This classification allows us to distinguish between hypoproliferative anemias, where the bone marrow is not producing adequate numbers of cells and anemias characterized by increased loss or destruction. The two categories, in turn, lead to two sets of diagnostic investigations, when assessed alongside the CBC parameters.

The complete blood count provides a large amount of information that also helps to guide the investigation of anemia. In particular, the MCV, RBC and hemoglobin can be used, along with the presence of reticulocytosis, to determine which further investigations may be relevant. The HCT, MCH, MCHC and RDW are calculated values on most analyzers, and are derived from calculations involving the directly measured parameters.

The reticulocyte count is also now available on many automated hematology analyzers. This represents a huge advance in the accuracy of reticulocyte counting, compared with older, manual methods. Manual reticulocyte counts are fraught with error owing to technical complexity, small volume dilutions, observer error and variance of the specific red cell features that identify a reticulocyte. Distribution error is also a concern due to the small number of cells counted on a manual count. Automated reticulocytes, in contrast, are both accurate and precise based on literature reports and validation by the Canadian Coalition for Quality in Laboratory Medicine (CCQLM).

Some examples of the investigation of various types of anemia using these recommendations follow:

Figure 1: Hemolysis Initial Workup

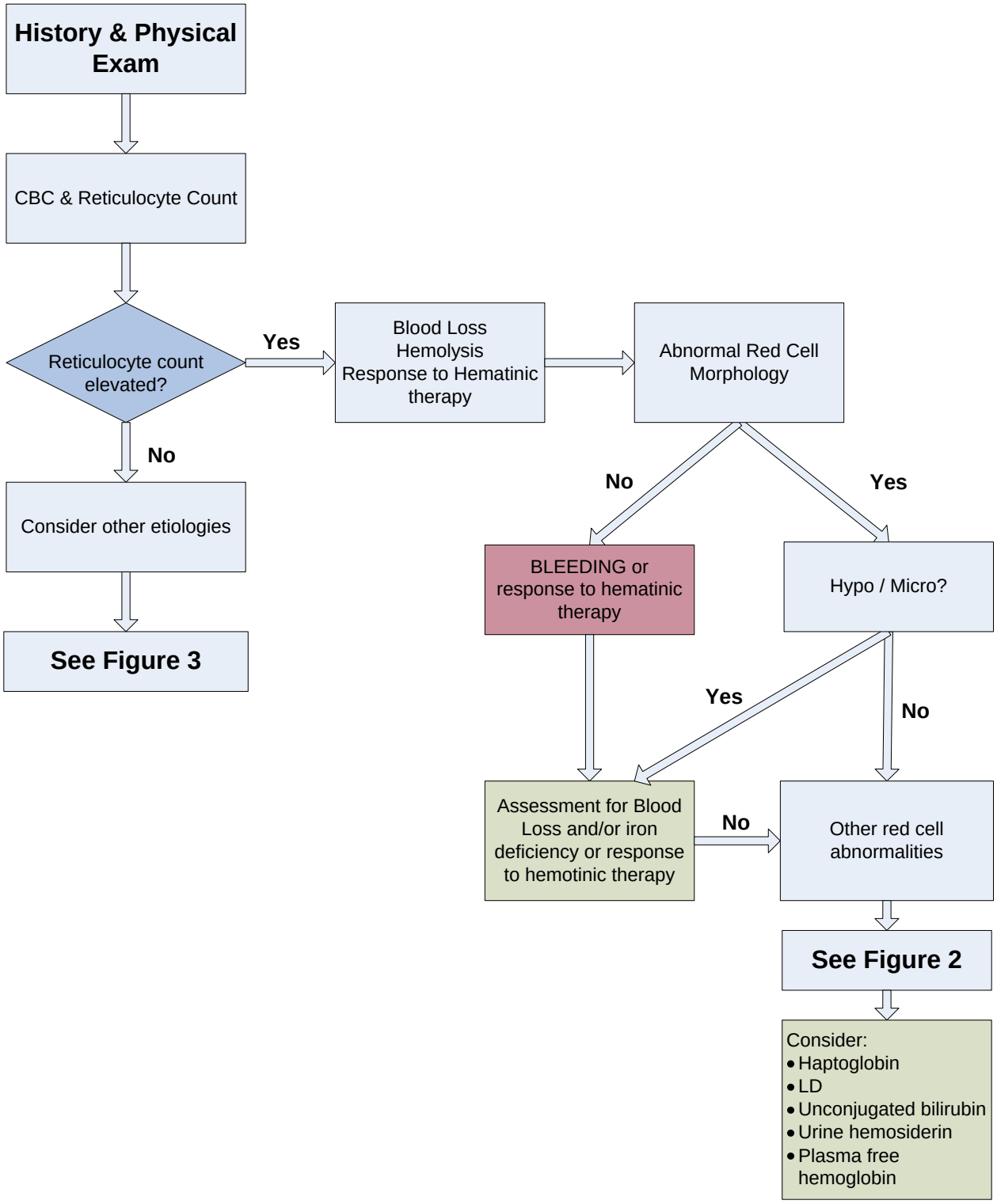


Figure 2: Hemolysis: Morphological Changes on Blood Film

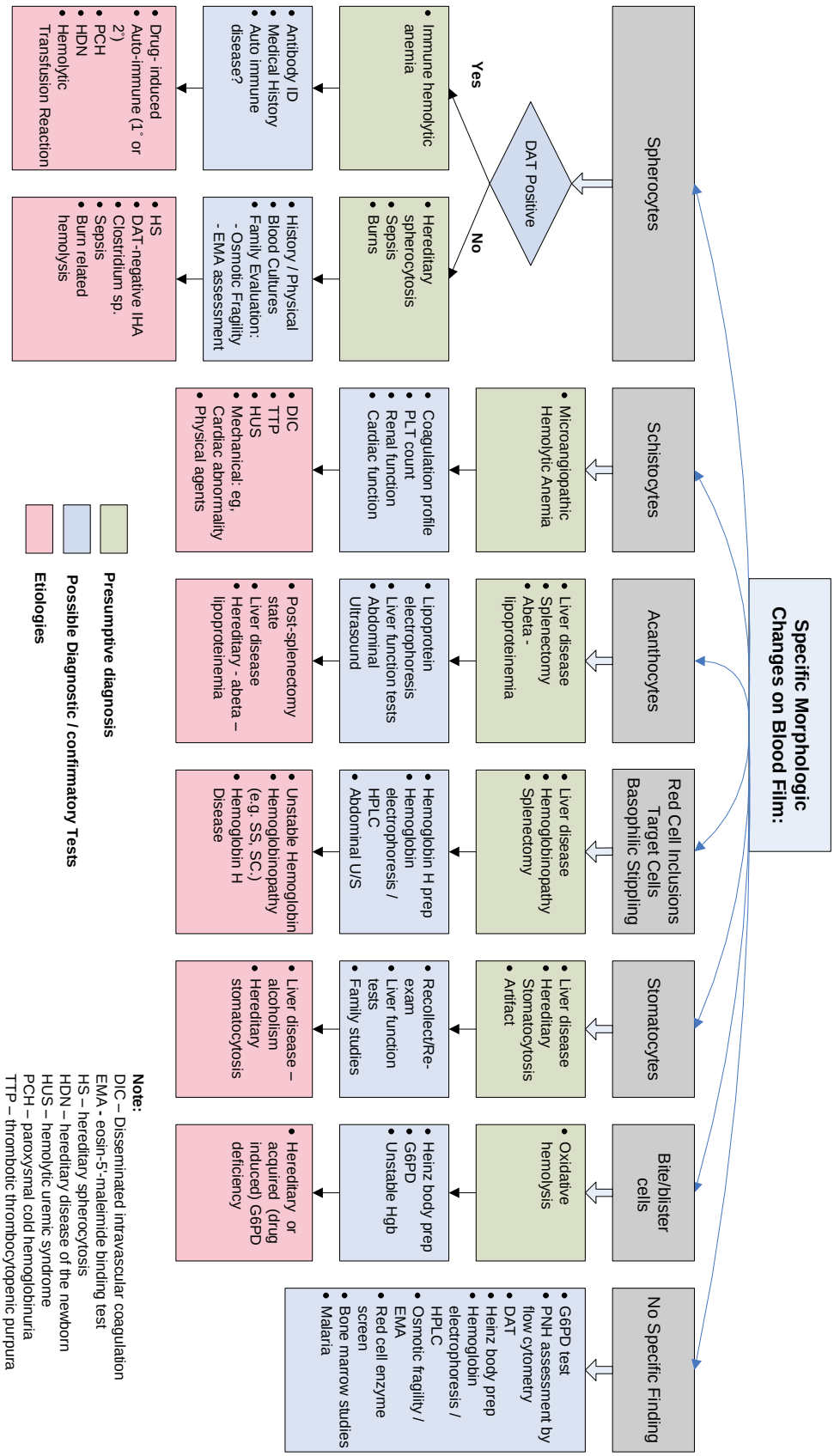
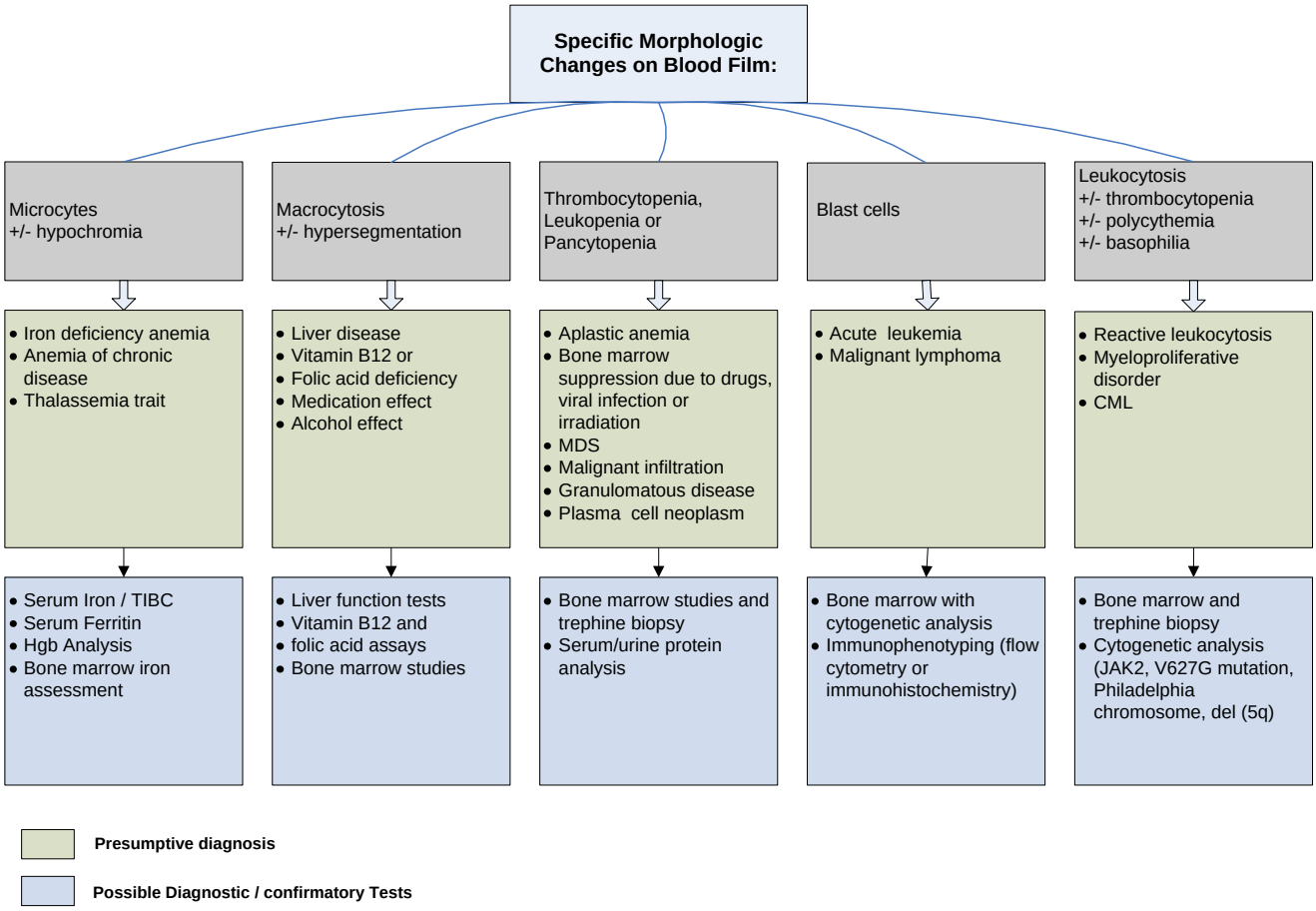


Figure 3: Hypoproliferative Anemias



References:

1. Glassy, Eric F., ed. - CAP Hematology and Clinical Microscopy Resource Committee. *Color Atlas of Hematology. 1998*; 56-57, 68-69, 80-90, 94-99, 122, 126, 132, 165
2. Bain, Barbara J. – *Blood Cells – A Practical Guide*. Fourth Edition. *2006*; 70-71, 219, 230-231, 311-366.
3. http://www.merck.com/mmpe/sec11/ch130/ch130b.html
4. http://www.merck.com/mmpe/sec11/ch130/ch130e.html