Contents

Preface: Hematology xi
Joanne B. Messick

Automated In-Clinic Hematology Instruments for Small Animal Practitioners: What is Available, What Can They Really Do, and How Do I Make a Choice? 1
Elizabeth G. Welles

The decision to purchase an in-office hematology instrument is typically based on the desire to have immediate access to complete blood count (CBC) data for disease diagnosis and follow-up and perhaps add to the financial bottom line of your practice. The decision regarding which in-office hematology instrument to purchase requires comparison of available instruments, how they function and knowledge of their strengths and limitations, what analytes they report, their ease of use, and their initial and continued costs. Other considerations include instrument space requirements, ability to interact with your existing data management system, the methods used by analyzers, and data accuracy.

Quality Management Recommendations for Automated and Manual In-House Hematology of Domestic Animals 11
Bente Flatland and Linda M. Vap

This chapter provides recommendations for minimizing preanalytical, analytical, and postanalytical error during hematology testing of mammals. These recommendations are not intended to be all-inclusive; rather, they provide a minimum standard for hematology quality assurance and the maintenance and use of hematology point-of-care analyzers. Written with the private practice setting in mind, the recommendations are also applicable to hematology in academic veterinary medical centers. Outlined are considerations for choosing a hematology instrument, nonstatistical quality assurance procedures important to hematology, and considerations for analyzing quality control materials. A commitment to quality, including ongoing continuing education and training of veterinarians and veterinary technicians, is required to yield reliable results.

Bone Marrow Cytologic and Histologic Biopsies: Indications, Technique, and Evaluation 23
Rose E. Raskin and Joanne B. Messick

Complete bone marrow evaluation should include a complete blood count (CBC), bone marrow cytologic biopsy, and bone marrow histologic biopsy. The CBC provides excellent quantitative and morphologic information. This information is complemented by the marrow cytology. When the cellularity of a bone marrow aspirate is low, it is difficult to
determine if this finding is due to “real” pathology or hemodilution of the sample. Histologic biopsy gives the best quantitative information regarding overall marrow cellularity. Methodical assessment should be made. Neglecting one or two parts of the evaluation often leaves unanswered questions; these three tests should be performed at the same time.

Coombs’ Testing and Its Diagnostic Significance in Dogs and Cats
K. Jane Wardrop

The Coombs’ test can detect both immunoglobulin and complement on the surface of red blood cells (RBCs), and as such can be of value as an aid in the diagnosis of immune-mediated hemolytic anemia (IMHA). Techniques that may improve sensitivity include use of monovalent reagents, increased dilutions of antiliglobulin to avoid a prozone effect, and testing at 4°C. These techniques are not without controversy; positive tests should always be interpreted in the presence of other clinical and hematologic evidence for IMHA. Alternate techniques, such as flow cytometry, can improve detection of RBC-bound immunoglobulin but require a flow cytometer and further laboratory standardization.

Principles and Applications of Flow Cytometry and Cell Sorting in Companion Animal Medicine
Melinda J. Wilkerson

Flow cytometry measures multiple characteristics of single cells using light scatter properties and fluorescence properties of fluorescent probes with specificity to cellular constituents. The use in the veterinary clinical laboratory has become more routine in veterinary diagnostic laboratories and institutions and reference laboratories. Common applications in small animal medicine includes quantitation of erythrocytes and leukocytes in automated hemology instruments, detection of antibodies to erythrocytes and platelets, immunophenotyping of leukocytes and lymphocytes in immunodeficiency syndromes or leukemias and lymphomas. DNA content analysis has not gained routine acceptance. Other applications including cell sorting and multiplexing are potential assays of the future.

Hemolytic Anemia in Dogs and Cats Due to Erythrocyte Enzyme Deficiencies
Jennifer L. Owen and John W. Harvey

The pathogenesis, laboratory diagnosis, and clinical implications of erythrocyte enzyme deficiencies in small animals are reviewed. Deficiencies of enzymes involved in erythrocyte metabolism can have significant effects on erythrocyte function and survival, resulting in hemolytic anemia. Animals with pyruvate kinase or phosphofructokinase deficiencies have shortened erythrocyte life spans and regenerative anemias, although the clinical presentations are very different. Understanding erythrocyte enzyme deficiencies and the tests needed
to diagnose them is important in the differential diagnoses of anemia in small animals. Although enzymopathies are rare causes of anemia, the ability to identify deficient animals allows for the possibility of eliminating these undesirable traits in future breeding.

**Role of Hepcidin in Iron Metabolism and Potential Clinical Applications**

Carolyn N. Grimes, Luca Giori, and Michael M. Fry

Systemic control of iron homeostasis depends largely on hepcidin, a peptide hormone discovered just over 10 years ago. The discovery of hepcidin has stimulated renewed research interest in iron metabolism and iron-related disorders, emphasizing the importance of this hormone in many normal and pathologic processes. This article provides a brief review of physiologic iron homeostasis, describes hepcidin’s structural and functional roles in physiologic and pathophysiologic iron-related processes, reviews important studies of hepcidin in veterinary species, and explores the diagnostic and therapeutic potential of hepcidin in human and veterinary medicine.

**Molecular Diagnostics of Hematologic Malignancies in Small Animals**

Anne C. Avery

Molecular diagnostic techniques will become more commonly available for diagnosis, prognosis, and treatment decisions in canine and feline malignancies. Presently, detection of c-kit gene mutations in canine mast cell tumors is a common component of mast cell tumor diagnosis, and the principles and limitations of this assay are described. Clonality assays are used in the diagnosis of feline and canine lymphoproliferative disorders and can be useful in investigating clinical issues such as quantifying tumor burden in the peripheral blood of a patient (minimum residual disease detection) and examining the relatedness of different tumors. Principles and limitations of these assays are discussed.

**Neutropenia in Dogs and Cats: Causes and Consequences**

Amy N. Schnelle and Anne M. Barger

Neutropenia in dogs and cats is a fairly common problem. The broad mechanisms include neutrophil destruction, decreased production, and increased tissue demand. Infectious, toxic, and neoplastic causes all have been associated with this hematologic abnormality. A thorough diagnostic plan is essential to identify the root cause of neutropenia.

**Hematologic Abnormalities in the Small Animal Cancer Patient**

Michael O. Childress

This article reviews the major hematologic abnormalities that may be identified in small animal cancer patients, including increases or decreases in circulating blood cells, coagulopathies, and plasma protein...
dyscrasias. These hematologic alterations may be hallmark features of certain malignancies and thus may serve as biomarkers of response to treatment or remission status, may complicate the therapeutic approach to the underlying tumor, and may have prognostic relevance. The etiopathogenesis, clinical significance, and tumor types most frequently associated with each of these abnormalities will be discussed. Where appropriate, a comparative review of similar hematologic findings in human cancer patients will be reviewed.

Neutrophil Function in Small Animals
Shannon Jones Hostetter

Neutrophils are motile phagocytes traditionally recognized for their role in innate immunity, representing the initial effector cell to eliminate bacterial and fungal pathogens. New evidence has highlighted their importance in numerous other processes, including the promotion and resolution of inflammation, amplification of adaptive immunity, and coagulation. Neutrophils are able to phagocytose and kill microbes, and create extracellular traps to ensnare and eradicate extracellular pathogens. Many of their diverse functions are linked to preformed proteins and effector molecules stored in granules. The importance of neutrophil function for animal health is emphasized through the discussion of inherited disorders of neutrophil function.

Evaluation and Clinical Application of Platelet Function Testing in Small Animal Practice
Pete W. Christopherson, Elizabeth A. Spangler, and Mary K. Boudreaux

Tests that evaluate many aspects of platelet function have been applied in both human and veterinary medicine to monitor treatment with platelet function inhibitors and detect platelet function abnormalities. Interspecies variation in the response to various platelet agonists is an important consideration when methods developed for people are applied in other species. Many of these assays are not available in standard veterinary practice. Advanced platelet function testing for veterinary patients is offered at select academic institutions. Discussion with a specialist is recommended when considering the use of these tests, and their relative strengths and limitations should be considered in interpretation of test results.

Laboratory Diagnosis of Disseminated Intravascular Coagulation in Dogs and Cats: The Past, the Present, and the Future
Tracy Stokol

The hemostatic system is an intricate co-operative network of proteins and cells that produces then dissolves fibrin clots. Disruptions in the balance between stimulatory and inhibitory forces that drive clotting and fibrinolysis cause hemorrhagic or thrombotic disorders, the most severe of which is disseminated intravascular coagulation (DIC). DIC is
a secondary complication of infections, inflammation and neoplasia. It contributes to morbidity and mortality through systemic microvascular thrombosis. Since clinical signs and imaging techniques are insensitive to thrombosis, laboratory testing is essential for DIC detection. Early diagnosis and mitigation can potentially improve survival and decrease hospitalization costs of affected animals.