Molecular diagnostics have revolutionized human oncology to allow early detection, targeted therapy, monitoring throughout treatment, and evidence of recurrence. By identifying genetic signatures associated with cancers, liquid biopsy techniques have been developed to diagnose and monitor cancer in noninvasive or minimally invasive ways. These techniques offer new opportunities for improving cancer screening, diagnosis, and monitoring the impact of therapy on the patients over time. Liquid biopsy also drives drug development programs. Similar diagnostics hold promise for comparable results in the veterinary field. Several noninvasive/minimally invasive techniques have been described in veterinary medicine that could be referred to as liquid biopsy.

Clinical staging is important for determining the extent of disease in animals with malignant cancers. The status of the lymph node will help determine whether adjuvant treatment is indicated. Historically, the regional anatomic lymph node has been sampled to determine the presence or absence of metastatic disease, but there is increasing evidence that the regional anatomic lymph node is often different to the sentinel lymph node. As a result, several sentinel lymph node mapping techniques have been described for more accurate clinical staging of oncologic patients.

We introduce a next phase in the evolution of medicine affecting human and veterinary patients. This evolution, genomic cancer medicine (Pmed), involves expansion of genomic and molecular biology into clinical medicine. The implementation of these new technologies has already begun and is a commercial reality. We introduce the underpinnings for this evolution, and focus on application in complex disease states. Pet owners have begun requesting Pmed technologies. To meet this demand, it is important to be aware of the opportunities and obstacles associated with available Pmed offerings as well as the current state of the field.

Canine cutaneous mast cell tumors (MCTs) are among the most common canine cutaneous tumors, with highly variable biological behavior. This
review describes in detail current approaches for cytologic and histologic diagnosis and prognosis, including advantages and limitations of cytologic and histologic grading and utilization of molecular markers, for example, Ki67, AgNORs, KIT expression, and c-Kit mutations, for a more accurate detection of aggressive MCTs. Furthermore, the current approach to evaluate surgical margins and spread to local lymph nodes is discussed.

Anorexia and the Cancer Patient

Chad M. Johannes and Margaret L. Musser

Appetite influences perceived quality of life for a dog or cat with cancer. Inappetence often is multifactorial, complicating treatment. Cancer-related anorexia/cachexia syndrome is a metabolic, paraneoplastic syndrome characterized by decreased food intake, involuntary weight loss, and loss of fat and muscle. If weight loss/cachexia has an impact on canine and feline cancer patients as in humans, management may improve survival times and quality of life. The challenge is having effective, proved therapies available for clinical use. Recent Food and Drug Administration approvals for appetite stimulation have renewed interest and discussion and has the potential to alter the course of case management.

Histiocytic Sarcoma and Hemangiosarcoma Update

Christine Mullin and Craig A. Clifford

Histiocytic sarcoma (HS) and hemangiosarcoma (HSA) are uncommon and aggressive neoplasms that develop much more frequently in dogs than in cats. Breed-specific predispositions have been identified for both cancers. The development of novel diagnostics is underway and may aid in earlier diagnosis. Therapeutic approaches to HS and HSA depend on the stage of disease and may include surgery, radiation therapy, and chemotherapy. Such interventions improve outcome; however, aside from a small number of clinical circumstances, both diseases are considered largely incurable. Continued efforts toward the identification of driver mutations and subsequent druggable targets may lead to improvements in long-term prognosis.

Cancer Immunotherapies

Philip J. Bergman

The enhanced understanding of immunology experienced over the last 4 decades afforded through the tools of molecular biology has recently translated into cancer immunotherapy becoming one of the most exciting and rapidly expanding fields. Human cancer immunotherapy is now recognized as one of the pillars of treatment alongside surgery, radiation, and chemotherapy. The field of veterinary cancer immunotherapy has also rapidly advanced in the last decade with a handful of commercially available products and a plethora of investigational cancer immunotherapies that will hopefully expand the veterinary oncology treatment toolkit over time.

Novel Treatments for Lymphoma

Douglas H. Thamm

Lymphoma is a common disease in companion animals. Although conventional chemotherapy has the potential to induce remission and prolong life,
relapse is common, and novel treatments are needed to improve outcome. This review discusses recent modifications/adjustments to conventional standard of care therapy for canine and feline lymphoma, as well as cutting-edge immunotherapy and small-molecule-based approaches that are in varying stages of regulatory approval.

**Targeted Therapies in Veterinary Oncology**

Priya Londhe, Megan Gutwillig, and Cheryl London

Advances in molecular biology have permitted a much more detailed understanding of cellular dysfunction at the molecular and genetic levels in cancer cells. This has resulted in the identification of novel targets for therapeutic intervention, including proteins that regulate signal transduction, gene expression, and protein turnover. In many instances, small molecules are used to disrupt the function of these targets, often through competitive inhibition of ATP binding or the prevention of necessary protein-protein interactions. More than 40 small molecule inhibitors are now approved to treat a variety of human cancers, substantially impacting patient outcomes.

**Update in Veterinary Radiation Oncology: Focus on Stereotactic Radiation Therapy**

Michael W. Nolan and Tracy L. Gieger

Stereotactic radiotherapy (SRT) involves the precise delivery of highly conformal, dose-intense radiation to well-demarcated tumors. Special equipment and expertise are needed, and a unique biological mechanism distinguishes SRT from other forms of external beam radiotherapy. Families find the convenient schedules and minimal acute toxicity of SRT appealing. Common indications in veterinary oncology include nasal, brain, and bone tumors. Many other solid tumors can also be treated, including spinal, oral, lung, heart-base, liver, adrenal, and prostatic malignancies. Accessibility of SRT is improving, and new data are constantly emerging to define parameters for appropriate case selection, radiation dose prescription, and long-term follow-up.

**Veterinary Clinics: Tumor Ablation**

William T.N. Culp and Maureen A. Griffin

Over the past decade, interventional oncology techniques have become integrated into the treatment plans of companion animals with cancer on a regular basis. Although procedures such as stenting are performed commonly, other less frequently utilized techniques for locoregional therapy, such as embolization and ablation, are emerging and demonstrating promise. Tumor ablation techniques are categorized into two subgroups: chemical ablation and energy-based ablation. Increased utilization of ablation will allow for the determination of specific indications and evaluation of outcomes for these techniques.

**Electrochemotherapy in Veterinary Oncology: State-of-the-Art and Perspectives**

Enrico Pierluigi Spugnini and Alfonso Baldi

Tumor microenvironment represents a key obstacle for the effectiveness of anticancer drugs. Electrochemotherapy involves the systemic or local
delivery of lipophobic drugs such as bleomycin and cisplatin, with the application of permeabilizing electric pulses having appropriate amplitude and waveforms. This greatly enhances the uptake of these drugs by an estimated factor of 700-fold for bleomycin and 4 to 8 times for cisplatin. Because of its efficacy and limited morbidity, this therapeutic option is becoming more and more available in veterinary oncology either as an adjuvant to surgery or as first line of treatment with palliative or curative purposes.