

STAY INFORMED Clients will have questions about popular “cancer diets,” making it critical for practitioners to understand how they might affect a patient.

NUTRITION NOTES

Nutrition for Small Animal Cancer Patients

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In the United Kingdom and the United States, the most commonly reported cause of death in dogs is cancer.^{1,2} When a patient is diagnosed with cancer, veterinarians may be faced with many challenging questions. Clients may ask about prior diets they have fed the dog and about feeding “cancer” diets and/or supplements in the future. One study reported that 51% of owners whose pet had cancer expressed distrust in their pet’s diet and 90% reported having changed the diet when they learned of the pet’s cancer diagnosis.³ Without proper guidance, clients may shift their feeding practices toward home-prepared or other diet types, which can be problematic. Reviews of publicly available pet recipes for raw or cooked home-prepared diets have shown these diets to be unbalanced, to present the risk of introducing foodborne illness, and/or to have insufficient instructions to ensure proper nutrition.⁴⁻¹¹

To advise clients, veterinarians need to rely on scientific evidence while respecting clients’ needs and perspectives. Human oncology patients may use nutrition, supplements, and natural products to empower themselves, attempt to take control of their health, and increase their quality of life. Acknowledging the concept of humanization (i.e., considering pets as family members), it is logical to expect and respect

these same emotional needs when clients are facing cancer in their pet. Clients are highly motivated to be a part of the healthcare of their pet with cancer and seek nutrition recommendations. Thus, the veterinarian and healthcare team need to educate clients about their pet’s nutrition at the time of cancer diagnosis and throughout treatment.

CANCER DIETS

Although research on cancer in dogs and cats continues to advance while availability of treatments (e.g., new drugs, immunotherapy, radiation protocols) and palliative care increases, research on nutrition for veterinary cancer patients remains scarce. Most reviews focus on management of anorexia or cachexia.^{12,13} Other than a study of lymphoma in dogs, no published feeding trials have examined the effects of different diet nutrient profiles on dogs that have cancer of various stages or are undergoing treatment.¹⁴ Regardless of this lack of research, clients want information about popular cancer diets, such as low-carbohydrate and/or ketogenic diets. Because cancer cell metabolism is often the rationale for advocating these types of cancer diets for pets, veterinarians should understand some of the underlying research.

Low-/No-Carbohydrate Diets

The best-known cancer cell metabolic abnormality was first described by Otto Warburg in the 1920s.¹⁵ Warburg reported that compared with normal tissue, tumors showed unusually high rates of glucose uptake and lactate production even in the presence of oxygen. This aerobic glycolysis, now called the Warburg effect (**BOX 1**),^{15,16} has given rise to the concept of low- or no-carbohydrate diets to “starve” cancer cells. However, subsequent cancer cell metabolism studies have determined that not all cancer cells survive by using aerobic glycolysis only; they also have metabolic flexibility.¹⁷⁻²² This flexibility involves adaptively upregulating and downregulating carbohydrate, fat, and protein metabolism as needed in response to nutrient availability, tumor microenvironment, and even cancer treatments. Some studies found cancer cell lines that use fat metabolism; others found different levels of carbohydrate, fat, and protein metabolism within the same cancer cells in solid tumors. These studies demonstrate that the nutrition recommendation to limit carbohydrates for patients with cancer is an oversimplification.

Ketogenic Diets

Another popular cancer diet that clients may ask about is a ketogenic diet. Ketogenic diets have the majority of total calories coming from fat, some as high as 80% to 90%. The macronutrient ratio of the ketogenic diet induces a metabolic shift toward fatty acid oxidation and hepatic ketogenesis, elevating ketone bodies in the blood. Again, the concept is to starve cancer cells of needed glucose for metabolism while allowing normal host cells to adapt and survive by using ketone bodies.²³⁻²⁵ Studies of mice and a few of humans with advanced cancers (e.g., glioblastoma) have

BOX 1 The Warburg Effect¹⁶

- Tumor cells use glucose via glycolysis to generate adenosine triphosphate.
- The end product of this aerobic glycolysis is lactate.
- Lactate is converted back to glucose.
- The glucose results in energy gained by the tumor and lost by the host.

demonstrated inhibition of tumor growth in those eating ketogenic diets, but results are controversial.²⁶⁻²⁸ Use of ketogenic diets for children and dogs with seizure disorders has shown some success.²⁹⁻³¹ A current veterinary therapeutic diet (VTD) for dogs with seizures contains medium-chain triglycerides rather than high amounts of fat.³² Currently, for veterinary patients with cancer, there are no clinical research studies to support the use of ketogenic diets.

Recommendations

Veterinarians should inform clients that feeding low-carbohydrate or ketogenic diets to all cancer patients is not supported by the research and may instead be problematic (**BOX 2**). Nutrition recommendations for each cancer patient should be individualized. The veterinarian should assess each patient with a specific cancer and treatment plan and generate a personalized nutrition plan that will be instituted, monitored throughout treatment, and changed as needed.

BOX 2 Problems with Low-Carbohydrate and/or Ketogenic Cancer Diets

- Research is lacking to support diets with these nutrient profiles for dogs and/or cats with cancer.
- These diets are required to be higher in protein and/or fat to replace carbohydrate calories.
- Increased fat is contraindicated for dogs with fat intolerance (pancreatitis, hyperlipidemia, chronic enteropathy with lymphangiectasia).
- Higher-fat diets may cause regurgitation, vomiting, and diarrhea and/or affect gastrointestinal motility.
- Increased protein is contraindicated for patients with renal disease and some liver diseases.
- Volume of food is less; therefore, the diet may be less satiating.

NUTRITION PLANS

A nutrition assessment for the cancer patient should include diet type, feeding method, patient appetite, and client's attitude toward the patient's current diet. Patient examination should include current and past body weights, body condition score, and muscle mass score. It is imperative to identify patients that are currently malnourished and inappetent or have signs of gastrointestinal dysfunction. A nutrition assessment of humans reported that 40% to 80% of cancer patients experience diverse degrees of malnutrition, depending on tumor subtype, location, stage, and treatment strategy.^{33,34} Inadequate nutrition can result from the cancer itself or from its treatment (TABLE 1). Effects may include physical damage to organs; disruption of the ability to eat normally; and damage to the intestinal tract, resulting in malabsorption.

For human cancer patients, initial and ongoing nutrition assessments are used for early identification of malnutrition and cancer cachexia.³⁵⁻³⁷ Cancer cachexia is defined as a collection of metabolic abnormalities associated with irreversible weight loss in tumor-bearing patients and is characterized by a loss of lean

body tissue, with or without fat mass. Because cachexia is not routinely recognized in veterinary medicine, the veterinary team should repeatedly assess the patient during cancer treatment/management.³⁷⁻³⁹ Guidelines for veterinary patients have been based on body weight assessment and trends derived from nutrition assessment protocols for human cancer patients (TABLE 2). These guidelines help veterinarians determine when to institute a new nutrition plan and/or refer the patient to an American College of Veterinary Nutrition (ACVN, acvn.org) Board Certified Veterinary Nutritionist.^{33,38,39}

Instituting a nutrition plan means identifying a potentially better diet and/or feeding plan. The authors prefer to use VTDs rather than over-the-counter (OTC) diets because VTD nutrient content is more easily accessible, digestibility can be higher, and they may be appropriate for gastrointestinal problems resulting from treatments or concurrent disease states. VTDs for joint, dermatologic, and/or gastrointestinal problems may be recommended for cancer patients because they may contain specific nutrients or functional ingredients (e.g., eicosapentaenoic acid,

TABLE 1 Identifiable Causes of Inadequate Nutrition in Veterinary Cancer Patients

CAUSE	ABNORMALITY
Cancer-associated	<ul style="list-style-type: none"> ■ Gastrointestinal obstruction ■ Intestinal secretory abnormalities ■ Dysmotility ■ Malabsorption ■ Fluid/electrolyte abnormalities ■ Insulin/neuroendocrine abnormalities
TREATMENT-ASSOCIATED	
Chemotherapy	<ul style="list-style-type: none"> ■ Anorexia ■ Altered taste ■ Food aversion ■ Nausea, vomiting ■ Malabsorption, diarrhea ■ Dysmotility, ileus
Surgery	<ul style="list-style-type: none"> ■ Malabsorption, diarrhea ■ Fluid/electrolyte abnormalities ■ Anemia
Radiation	<ul style="list-style-type: none"> ■ Anorexia ■ Altered taste ■ Mucositis, enteritis ■ Xerostomia ■ Stomatitis and mucositis (which make eating painful) ■ Dysphagia ■ Strictures
Other	<ul style="list-style-type: none"> ■ Opioid/drug-induced dysmotility ■ Gastrointestinal infection, dysbiosis ■ Tumor/treatment-associated pain ■ Hospitalization, confinement, sedation (which disrupt routines and regular feedings) ■ Stress, anxiety, fear ■ Pain relief medication (which may affect appetite or gastrointestinal motility)

docosahexaenoic acid, fiber, antioxidants).^{14,40} The benefits of VTDs compared with OTC pet foods should be communicated to the client.⁴¹ For cancer patients that have undergone significant weight loss, persistently lose weight, or have a rapidly progressive/unresponsive cancer, referral to an ACVN Board Certified Veterinary Nutritionist should be discussed.

EFFECTS OF BODY WEIGHT

Studies involving humans have indicated that dietary (caloric) intake profoundly affects cancer therapy outcomes as measured by survival rates and quality of life.^{33,35} A retrospective study of dogs with lymphoma or osteosarcoma reported decreased survival times among dogs with lymphoma that were underweight at the time of diagnosis and improved survival times among those that gained weight by 10% or more compared with dogs that maintained or lost weight.⁴² The authors concluded that weight loss during cancer treatment indicated a poor response to treatment, progressive disease, or suboptimal nutrition. Simply put, the priority is to maintain patients' body weight by keeping them eating.

The Underweight Patient

For underweight patients or those losing weight, assisted feeding for the short or long term should be considered early to improve the patient's quality of life and outcomes. Many veterinarians recommend intervention after 3 to 5 days of anorexia; however, to prevent malnutrition and cachexia, nutrition interventions for hyporexic patients (consuming less than resting energy requirements) should be considered early in the treatment plan (i.e., within the first week of case management). Adjustment to the nutrient profile is required for patients with comorbidities (e.g., liver or kidney disease, pancreatitis, hyperlipidemia). Food intolerances or allergies may limit ingredient or nutrient options. Should food aversions develop, some

patients will need several diet options or a rotation of foods and/or textures. Often homemade diets or fresh food diets may be more palatable and appealing for dogs or cats with variable appetites. The top priority is to provide palatable food that the patient will readily consume and tolerate and that will prevent weight loss. To increase daily caloric intake, the veterinary team can recommend increasing feeding frequency or hand-feeding a palatable diet while leaving dry food accessible throughout the day. The veterinary team can also consult with a certified nutritionist to provide different nutrition plans and feeding strategies for clients of dogs or cats with cancer.

The Overweight/Obese Patient

Research on obesity and veterinary cancer patients is insufficient. Romano et al. reported that obesity was not associated with adverse outcomes among dogs with lymphoma or osteosarcoma.⁴² That finding indicates that it would be logical to avoid aggressive weight loss programs for veterinary patients with cancer that will affect their life span (i.e., those more likely to succumb to the cancer than to the effects of obesity). If weight is severely limiting the patient's mobility and affecting quality of life, a cautious weight-reduction plan may be considered. Marshall et al. found that weight reduction of 6% improved lameness scores in osteoarthritic dogs;⁴³ therefore, this guideline may be reasonable for cancer patients. A diet formulated for weight loss should be used because adult maintenance or weight-management diets may result in nutrient deficiencies.⁴⁴ The potential benefits of a weight-loss plan should be discussed with clients because reducing calorie intake in a cancer patient may not align with their needs or beliefs.

NEW CONCEPT: INTERMITTENT FASTING

A growing area of nutrition research for humans with cancer is intermittent fasting. The concept is that

TABLE 2 Assessment of Body Weight to Determine if Nutrition Plan Change Is Needed

BODY WEIGHT	NUTRITION PLAN
Same, stable	No change needed
<5% unintended weight loss	Institute new nutrition plan
≥5% unintended weight loss over preceding 6 months or ongoing weight loss ≥2%	Institute new nutrition plan and/or consider referral to board-certified veterinary nutritionist
Cachexia and/or rapidly progressive cancer unresponsive to treatment	Consider referral to board-certified veterinary nutritionist

during fasting, normal cells are free to enter a “cleanup” phase, in which damaged cell organelles and misfolded proteins are cleared, a process known as autophagy.⁴⁵ Lack of autophagy or dysfunctional autophagy may contribute to many diseases, including cancer. Autophagy may be modified by nutrition restriction, thereby modulating and enhancing efficacy of anticancer therapies while protecting normal cells from side effects of chemotherapy.⁴⁶ One study documented decreased incidence of delayed-type vomiting associated with doxorubicin in dogs with lymphoma fasted for 24 hours before treatment.⁴⁷ Evaluations of the effects of fasting on treatment-emergent adverse events and outcomes are ongoing.

SUMMARY

Veterinarians face multiple questions and challenges with regard to patients with cancer. They need to rely on scientific evidence while also addressing clients’ perspectives and needs. Answering client questions, discussing the role of diet, and instituting appropriate nutrition plans provide an opportunity to improve management of the veterinary cancer patient. Educating clients and providing thoughtful, personalized nutrition plans seem to increase the quality of patients’ lives while improving client/veterinarian relationships. **TVP**

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