

Cardiac Disease – Canine

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Definition

Cardiac diseases are common in dogs, affecting approximately 11% of all dogs, and can be congenital or acquired, and may affect the heart valves, the myocardium, or conduction pathways. *Heart failure* occurs when the cardiac disease becomes severe enough that the heart cannot pump blood to sufficiently supply all tissues. Clinical signs, ranging in severity from mild to severe, typically accompany heart failure. In *congestive heart failure* (CHF), the impaired cardiac function results in elevated venous pressure and resultant fluid accumulation (e.g., pulmonary edema, pleural effusion, ascites). Heart failure is the final common pathway of most cardiac diseases. The most common cardiac disease in dogs (>75% of all cardiac disease) is *chronic valvular disease* (CVD), while the second most common is *dilated cardiomyopathy* (DCM). *Congenital heart diseases* also occur, particularly in certain breeds. All of these cardiac diseases can result in heart failure. There are a number of systems to classify the severity of cardiac disease. One is the International Small Animal Cardiac Health Council (ISACHC) classification of heart failure (Table 1).

Key Diagnostic Tools and Measures

Body weight (BW), body condition score (BCS; see Appendix I), muscle wasting, appetite/food intake (diet history; see Appendix II), clinical signs (e.g., coughing, difficulty breathing, ascites, weakness, syncope, vomiting, diarrhea), and laboratory values including BUN, creatinine, electrolytes, hematocrit, and taurine (plasma and whole blood if taurine deficiency is suspected) should be considered in the diagnosis of cardiac disease in dogs. Other tests, if indicated, could include thoracic radiographs, blood pressure, electrocardiography, Holter monitor, and echocardiography.

Pathophysiology

Alterations in animals with heart failure that impact nutritional management include the following.

Calories. Many animals with cardiac disease, particularly when CHF arises, have reduced food intake. This can be the result of increased production of inflammatory mediators (e.g., cytokines, oxidative stress), side effects of cardiac medications, or poor control of heart failure signs.

Protein/Amino Acids. Muscle loss (cachexia) occurs in animals with heart failure as a result of reduced appetite, increased energy requirements, and pro-inflammatory cytokines. Taurine deficiency may be present in certain breeds of dogs with DCM (e.g., cocker spaniel, golden retriever, Newfoundland, St. Bernard, Portuguese water dog puppies), and has also

been associated with lamb meal and rice, high-fiber, or very-low-protein diets. Arginine may be a factor, as endothelial function may be impaired in animals with CHF, contributing to impaired exercise tolerance.

Fat. Dogs with CHF have been shown to have a relative deficiency of the n-3 fatty acids, eicosapentaenoic acid (EPA) and docosahexaenoic acid (DHA), compared with healthy controls. n-3 fatty acids reduce inflammatory mediators and have anti-arrhythmic effects.

Minerals. Sodium and water retention occur in heart failure due to activation of the renin-angiotensin-aldosterone system. Hypokalemia may occur in dogs receiving loop (e.g., furosemide) or thiazide (e.g., hydrochlorothiazide) diuretics. Hypokalemia can increase the risk for cardiac arrhythmia. Hyperkalemia can occur in dogs receiving angiotensin-converting enzyme (ACE) inhibitors or potassium-sparing diuretics (e.g., spironolactone). Dogs receiving high doses of diuretics are at risk for hypomagnesemia, which can increase the risk for cardiac arrhythmia.

Vitamins. Increased urinary losses of B vitamin may occur in dogs receiving diuretics.

Other Nutrient Issues. Carnitine deficiency has been reported in a family of Boxers with DCM. Carnitine supplementation may improve energy metabolism in animals with CHF. In addition, dogs with CHF have increased oxidative stress (i.e., an imbalance between oxidant production and antioxidant protection)

Signalment

Chronic valvular disease (CVD) is the most common cardiac disease in dogs and typically affects small- and medium-sized breeds. Some breeds at increased risk for CVD include the Cavalier King Charles spaniel, Chihuahua, dachshund, miniature schnauzer, and toy and miniature poodles. Dilated cardiomyopathy (DCM) generally is found in large- and giant-breed dogs, such as the Doberman pinscher, boxer, Irish wolfhound, and Great Dane. Some dogs with DCM may have taurine deficiency; predisposed breeds include the cocker spaniel, Saint Bernard, golden retriever, Newfoundland, and Portuguese water dog puppies. Breeds with DCM that do not typically develop DCM (e.g., dachshund, corgi) also may have taurine deficiency.

Key Nutrient Modifications

Calories. Ensuring adequate calorie intake to maintain optimal BW is critical. Obesity can be present, particularly in dogs with early (asymptomatic) cardiac disease. As CHF develops, weight (and muscle) loss becomes common so ensuring adequate calorie intake often is critical at this stage.

Table 1. International Small Animal Cardiac Health Council (ISACHC) Classification of Heart Failure*

1. Asymptomatic

Heart disease is detectable but patient is not overtly affected and does not demonstrate clinical signs of heart failure. Diagnostic findings could include a cardiac murmur, arrhythmia, or cardiac chamber enlargement that is detectable by radiography or echocardiography

1a Signs of heart disease are present but no signs of compensation, such as volume or pressure overload ventricular hypertrophy, are evident

1b Signs of heart disease are present in conjunction with radiographic or echocardiographic evidence of compensation, such as volume or pressure overload ventricular hypertrophy

2. Mild to Moderate Heart Failure

Clinical signs of heart failure are evident at rest or with mild exercise and adversely affect quality of life. Typical signs of heart failure include exercise intolerance, cough, tachypnea, mild respiratory distress (dyspnea), and mild to moderate ascites. Hypoperfusion at rest is generally not present.

3. Advanced Heart Failure

Clinical signs of advanced congestive heart failure are immediately obvious. These clinical signs include respiratory distress (dyspnea), marked ascites, profound exercise intolerance, or hypoperfusion at rest. In the most severe cases, the patient is moribund and suffers from cardiogenic shock. Death or severe debilitation is likely without therapy.

3a Home care is possible

3b Hospitalization is mandatory because cardiogenic shock, life-threatening pulmonary edema, refractory ascites, or a large pleural effusion is present.

*From International Small Animal Cardiac Health Council. Recommendations for the Diagnosis of Heart Disease and the Treatment of Heart Failure in Small Animals, 1994.

Protein/Amino Acids. Normal to increased protein intake should be the goal to help counteract muscle loss. Protein restriction should be avoided unless severe concurrent renal disease is present. In dogs with DCM that are of breeds predisposed to taurine deficiency or breeds that do not typically develop DCM, taurine concentrations should be determined and taurine supplementation should be initiated while waiting for results. Taurine also may have some benefits due to its antioxidant and positive inotropic effects. Arginine supplementation has been shown in other species to improve the endothelial dysfunction associated with CHF. This has not yet been tested in dogs.

Fat. The anti-inflammatory and antiarrhythmic effects of n-3 fatty acids have many potential benefits in animals with cardiac disease. n-3 fatty acid supplementation reduces muscle loss in dogs with CHF and improves appetite in some animals. In addition, n-3 fatty acids have been shown to reduce ventricular arrhythmias in Boxers with arrhythmogenic right ventricular cardiomyopathy. n-3 fatty acids can be provided in diets that are highly enriched with this form of fat or as a dietary supplement.

Minerals. Severe sodium restriction is not recommended in early (asymptomatic) cardiac disease as sodium restriction activates the renin-angiotensin-aldosterone system. In early cardiac disease, the goal should be to avoid excessive sodium intake and to educate the owner about treats and table foods high in sodium. As the cardiac disease progresses and CHF develops, greater sodium restriction is indicated; this can help to reduce the diuretic doses required to control clinical signs. Controlling sodium intake from the dog food is important but it is also critical to ensure that other sources of sodium intake are addressed, such as treats, table foods, and foods used to administer medications.

Recommended dietary potassium modifications will depend upon medications being administered and serum potassium concentrations. Canine diets have a wide range of potassium content so using one appropriate for the individual patient is important (e.g., avoiding high-potassium diets in dogs with hyperkalemia). Consequently, serum potassium should be monitored, especially as more medications are administered to a patient.

Serum magnesium should be monitored, especially in dogs receiving high doses of diuretics. Magnesium should be supplemented in dogs with hypomagnesemia.

Vitamins. Most cardiac diets contain increased levels of B vitamins. If high doses of diuretics are being administered, B-vitamin supplementation may be indicated.

Other nutrients. L-carnitine supplements can be offered to owners who wish to be able to provide dietary supplements to their dogs with DCM *in addition* to the dog's cardiac medications (be careful to avoid a situation in which an owner gives supplements in place of cardiac medications). The prevalence of primary carnitine deficiency as a cause for DCM is likely low although Boxers may be a breed that is predisposed. Carnitine, however, also may improve myocardial energetics in dogs with CHF.

Coenzyme Q10 is sometimes recommended for dogs with DCM as an antioxidant and to aid in myocardial energy metabolism. No controlled studies have been performed in dogs with spontaneous cardiac disease and results from other species are conflicting on the potential benefits of supplementing coenzyme Q10.

Antioxidant supplementation was shown to reduce oxidative stress in one study of dogs with CVD; however, the effects on disease progression and clinical outcome are not known.

Recommended Ranges of Key Nutrients

Nutrient	mg/100 kcal	mg/100 kcal
	Recommended dietary level	Minimum dietary requirement*
Protein (g)	5.5–8	5.1
Sodium (mg)	35–100 (depends on stage of disease)	17

Modified intake of certain nutrients may help address alterations induced by cardiac disease or medications used to manage the disease. The recommended dietary composition is shown as g or mg per 100 kcal metabolizable energy. All other essential nutrients should meet normal requirements adjusted for life stage, lifestyle, and energy intake and energy intake, except for those otherwise noted in the text. Correction of negative energy balance, if present, is critical.

*Nutrient requirement for adult animals as determined by the Association of American Feed Control Officials

Therapeutic Feeding Principles

Avoid making big dietary changes when a dog is hospitalized for an acute episode of CHF. Continue feeding the dog's usual diet (unless very high in sodium), but have the owner discontinue any high-sodium treats or table foods. When the dog returns in 7 to 10 days for re-evaluation, a gradual change to a more appropriate diet can be instituted. This helps to avoid food aversions that can develop when a new diet is imposed on an acutely sick dog.

Calories should be adjusted to maintain optimal body condition (e.g., reducing calorie intake in obese animals; increasing calorie intake in animals that are below optimal body weight/condition).

Protein/Amino Acids. The diet should contain ≥ 5.1 g protein/100 kcal. Note that many canine cardiac diets are low in protein. Diets < 5.1 g protein/100 kcal should be avoided unless concurrent renal disease is present. In dogs with DCM that are of breeds predisposed to taurine deficiency or breeds that do not typically develop DCM, taurine concentrations should be determined and taurine supplementation should be initiated while waiting for results (250–1000 mg every 8–12 hours).

Fat. The optimal dose of n-3 fatty acids has not been determined; however, the author currently recommends a dosage of fish oil to provide 40 mg/kg EPA and 25 mg/kg DHA for animals with anorexia or cachexia. Unless the diet is one of a few specially designed therapeutic diets, supplementation will be necessary to achieve this n-3 fatty acid dose. Fish oil supplements vary in their concentration of EPA and DHA so the author recommends a 1-gram capsule that contains 180 mg EPA and 120 mg DHA. At this concentration, fish oil can be administered at a dose of 1 capsule per 10 pounds of body weight. Alternatively, a liquid form of n-3 fatty acids (e.g., Cardiguard, Boehringer Ingelheim, which contains 420 mg EPA and 280 mg DHA per gram) can be used. It should be noted that if the owner cannot administer the capsule, the dog will be exposed to the very strong flavor of the fish oil. While some dogs appear to enjoy the taste, others do not. In dogs that dislike the flavor, administration of n-3 fatty acids may not be possible due to adverse effects on food intake. Fish oil supplements should contain vitamin E as an antioxidant, but other nutrients should not be included to avoid toxicities. Cod liver oil and flax oil should not be used to provide n-3 fatty acids.

Minerals. With regard to sodium:

- ISACHC Stage 1: Counsel the owner to avoid diets high in sodium (> 100 mg/100 kcal) and to avoid high-sodium treats and table food.
- ISACHC Stage 2: The goal should be for < 80 mg/100 kcal in the dog food. Sodium intake from other foods (e.g., treats, table food, foods used for medication administration) also will be important.
- ISACHC Stage 3: The dog food should be < 50 mg/100 kcal although anorexia may require more leniency in sodium content in the diet (< 80 mg/100 kcal) in order to provide greater choice. Controlling sodium

intake from other foods (e.g., treats, table food, foods used for medication administration) is important as these can be major sources of sodium.

Recommended dietary potassium modifications will depend upon medications being administered and serum potassium concentrations. Diets high in magnesium or an oral magnesium supplement should be used in dogs with hypomagnesemia.

Vitamins. If high doses of diuretics are being administered, B vitamin supplementation may be indicated.

Other Nutrients. The minimum or optimal dose of L-carnitine necessary to replete a dog with low myocardial carnitine concentrations is not known, but the dose that has been recommended is 50–100 mg/kg orally (PO) every 8 hours. For coenzyme Q10, the current recommended (but empirical) dose in dogs is 30–90 mg PO twice daily, depending upon the size of the dog.

■ **Treats** – Most dogs with cardiac disease (>90% in one study) receive treats and table foods. Therefore, this issue is important to address with owners. Making specific recommendations to owners regarding treats that are appropriate (and those that should be avoided) is important as most commercial dog treats are high in sodium and most people are unaware of the sodium content of “people food.” Foods to be avoided include most commercial dog treats (unless specifically determined to be low in sodium), baby food, pickled foods, bread, pizza, lunch meats and cold cuts, condiments (e.g., ketchup, salsa), most cheeses, processed foods (e.g., rice mixes, macaroni and cheese, frozen meals), canned vegetables (unless the label states “sodium free” or “very low sodium”), rawhide chews, canned soups, and snack foods (e.g., potato chips, crackers). Acceptable treats include fresh fruits (e.g., apples, oranges, bananas; avoid grapes), fresh vegetables (e.g., carrots, green beans; avoid onions or garlic), dog treats that are determined to be low in sodium (<20 mg sodium/treat for medium-large sized dogs; <10 mg/treat for small dogs). Note that even low-sodium treats and foods can provide large doses of sodium if they are fed in large quantities, particularly for small dogs.

It also is important to provide the owner with appropriate methods for administering medications as many dog owners use foods to administer medications and many common foods used are high in sodium. The owner can be taught to administer the pill without using foods (either by hand or using a device designed for this purpose). Alternatively, foods such as fresh fruits (e.g., bananas, melon), low-sodium canned pet food, peanut butter (labeled as “no salt added”), or home-cooked meat (without salt; not lunch meats) can be used. Finally, a compounded liquid medication can be considered although the pharmacokinetics of compounded medications may be significantly altered.

■ **Tips for Increasing Palatability** – Dogs with CHF often have cyclical appetites (i.e., they will eat a food well for 7 to 14 days but then stop eating it). While reductions in appetite in a dog that was previously eating well can indicate the need for reassessment and medication adjustment, sometimes providing a different food will increase appetite again. Communicating with the owner about these issues can help to reduce anxiety.

Palatability enhancers such as home-made, low-sodium broth (e.g., chicken, beef) can enhance palatability. Most store-bought broths are high in sodium, even if labeled “low sodium.” Cooked chicken, beef, or fish can be added to the food. Dogs with CHF often prefer sweet flavors. Therefore, adding vanilla or fruit yogurt, maple syrup, or applesauce to the food often improves palatability and food intake. n-3 fatty acids will often improve appetite in dogs with CHF; however, it will take 2 to 4 weeks to see effects. Appetite stimulants can be considered (e.g., cyproheptadine, mirtazepine). Dogs with CHF often have preferences for food temperature (i.e., some will only eat foods at room temperature, some prefer cold foods, some prefer warmed foods). Encourage the owner to experiment to determine which temperature works best for their dog. Sometimes feeding the dog from a dinner plate (rather than the dog food bowl) and in a place different from their usual site can improve appetite.

Client Education Points

- Make specific diet and treat recommendations (types and amounts).
- Warn owner about common alterations in appetite in dogs with heart failure.
- Give the owner appropriate methods for medication administration.
- Ask at each visit if the owner is administering dietary supplements. If so, ensure that the supplements are safe, are not interacting with the diet or medications, and are being administered at an appropriate dose.
- In addition to safety and efficacy issues, there are significant concerns about the quality control of dietary supplements (e.g., quality control, bioavailability). Therefore, veterinarians should consider recommending specific brands of dietary supplements that bear the logo of the United States Pharmacopeia Dietary Supplement Verification Program (DSVP), which tests human dietary supplements for ingredients, concentrations, dissolvability, and contaminants. Another good resource is Consumerlab.com, which performs independent testing of dietary supplements (primarily human supplements but also some pet products).

Common Comorbidities

In one study, 61% of dogs with cardiac disease had at least one concurrent disease. Therefore, the nutritional goals may need to be modified for a dog with heart failure that has a concurrent, nutrient-sensitive disease (e.g., a dog with CHF and chronic renal failure or gastrointestinal disease).

Interacting Medical Management Strategies

Drug–nutrient interactions are common in CHF. Loop (e.g., furosemide) or thiazide (e.g., hydrochlorothiazide) diuretics can increase the risk for hypokalemia and hypomagnesemia, while ACE inhibitors and potassium-sparing diuretics (e.g., spironolactone) can increase the risk for hyperkalemia. Azotemia can result from overzealous use of diuretics. Anorexia can be a side effect of many cardiac medications (e.g., diuretics, digoxin, ACE inhibitors).

Monitoring

Reductions in appetite/food intake may indicate the need for dietary modifications but also may be an early sign of decompensation of the cardiac disease or the need for medication adjustment. Body weight should be monitored in obese dogs in order to achieve optimal weight. In animals with cachexia that are losing weight/muscle, dietary modifications are needed to minimize weight/muscle loss. Note that in animals with right-sided CHF, fluid accumulation (pleural or peritoneal effusion) can mask weight loss but weight and muscle loss is very common in these dogs so “dry weight” and muscle loss should be carefully monitored.

Body condition score (BCS) is helpful for monitoring animals with asymptomatic disease and those that are overweight or obese. Note that BCS systems assess fat stores but not muscle, so an animal can be overweight or obese but still have muscle wasting. Therefore, monitoring BW, BCS, and the degree of muscle wasting is important. Muscle loss is typically first noted in the temporal, epaxial, and gluteal muscles. A muscle condition score is being developed that subjectively categorizes muscle mass into four categories: No muscle wasting, mild muscle wasting, moderate muscle wasting, and marked muscle wasting. Intervening at an early stage (mild or moderate muscle wasting) provides improved opportunities for reversing or minimizing the degree of muscle wasting.

Clinical signs (e.g., coughing, difficulty breathing, weakness, syncope, vomiting, diarrhea), laboratory values (BUN, creatinine, electrolytes, hematocrit), and other measures, if indicated (e.g., thoracic radiographs, blood pressure, electrocardiography, Holter monitoring, echocardiography) should also be monitored.

Algorithm – Evaluation of Nutritional Issues in Canine Cardiac Disease

