

# Hyperlipidemia – Feline

John E. Bauer, DVM, PhD, DACVN

## Definition

*Hyperlipidemia* is defined as an increase in serum concentrations of triglyceride (TG) or cholesterol or both.

## Key Diagnostic Tools and Measures

The presence of lipemic serum suggests hypertriglyceridemia but not hypercholesterolemia. In some cases, the triglyceride concentrations may be sufficiently elevated (typically >1000 mg/dL) and lipoprotein particles large enough to impart an opaque or milky appearance (*lactescence*). Pure hypercholesterolemia does not impart lactescence. Blood samples to confirm should be collected after a 12- to 18-hour fast. Refrigeration of the sample for 12 hours is helpful to determine whether the triglyceride is associated with postprandial (chylomicron) particles or endogenous (very low density lipoprotein [VLDL]) particles. Chylomicrons are less dense and will float under this condition while VLDL will remain suspended in the sera. Waxing and waning vomiting, diarrhea, or abdominal discomfort may be present.

## Pathophysiology

The most common cause is *postprandial hyperlipidemia*. This is a normal phenomenon resulting from the appearance of chylomicrons in the circulation 2 to 6 hours after fat ingestion and usually resolving after approximately 10 hours. One recognized *primary hyperlipidemia* of cats results from an inherited defect of lipoprotein lipase metabolism. In this case, reduced clearance (catabolism) of triglyceride-rich postprandial (i.e., chylomicron) and/or endogenous (i.e., VLDL) particles occurs. *Primary hypercholesterolemia* also exists; cholesterol elevations are typically associated with low-density lipoprotein (LDL) or high-density lipoprotein (HDL) elevations but rarely result in lactescent serum.

*Cutaneous xanthomas* due to lipid-laden macrophages and foam cells are the most common manifestation of hyperlipidemias in cats. Severe hypercholesterolemia may be associated with lipemia retinalis, arcus lipoides, and, more rarely, atherosclerosis. *Secondary hyperlipidemias* may exist in which triglyceride elevations develop due to increased chylomicron or VLDL production, decreased catabolism, or a combination of both due to some other primary disorder

## Signalment

No breed predispositions have been identified to date.

## Key Nutrient Modifications

Key nutrients for management of primary hyperlipidemias include low-fat diets (< 20% of metabolic energy) and increased long-chain omega-3 fatty acid intake. In the case of secondary forms (i.e., comorbidities), attempts should be made to identify the underlying cause (see below) and institute dietary management and other techniques to control the metabolic disturbances identified.

## Recommended Ranges of Key Nutrients

Nutrient	% DM	g/100 kcal	% DM	g/100 kcal
	Recommended dietary level		Minimum dietary requirement*	
Fat	5–10	1.2–2.3	9.0	2.2
		mg/100 kcal		
DHA+EPA#	0.3–1.25	75–330	n/a	n/a

Modified intake of these nutrients may help address metabolic alterations induced by disease states. The recommended dietary composition is shown as percent of dietary dry matter (DM) and 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.

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

#Docosahexaenoic acid (DHA) and eicosapentaenoic acid (EPA), long-chain omega-3 fatty acids from fish oil. Standard fish oil contains 30% EPA + DHA

## Therapeutic Feeding Principles

Diet histories should be obtained focusing on dietary fat content. Initial client discussion will ideally focus on efforts to restrict dietary fat content of an existing diet (elimination of treats or table scraps where fed), and other recommendations made to restrict fat, such as a total diet change. Numerous therapeutic diets are available including those primarily recommended for obesity management, gastrointestinal disorders, and even hypoallergenic diets as long as they are reduced in dietary total fat.

Diets rich in marine omega-3 fatty acids may be especially helpful in the context of an overall low-fat dietary approach but are not well studied to date. Supplementation of existing low-fat diets with fish oils may be more appropriate rather than feeding a high-fat diet containing the omega-3 oils, which may preclude any benefit. Marine (or long-chain omega-3 fatty acids) are necessary rather than vegetable omega-3s because the triglyceride-lowering effect is primarily due to docosahexaenoic acid (DHA), which is poorly synthesized from vegetable-based precursors.

The inclusion of soluble dietary fiber interferes with the enteric reabsorption of cholesterol and bile acids and may help reduce hypercholesterolemic states. Dry diets are usually lower in cholesterol than canned diets and may be lower in total fat overall.

■ **Treats** – Treats are not recommended unless they are known to be low in fat.

■ **Tips for Increasing Palatability** – Obviously, the use of dietary oils to improve palatability is contraindicated. Moistening dry-expanded type foods is suggested, or a diet change within the low-fat category can be made. Using a low-fat canned food top-dressed on dry food may improve acceptance in some cases as long as total fat and calories remain controlled.

■ **Diet Recommendations** – Several forms of low fat diets are available primarily as therapeutic diets. Both canned and dry-extruded varieties exist but fat content of these, even with the same product name, may be different so caution is urged in selecting the most appropriate commercial product. Canned products often have a higher fat content even though they have the same product name as the dry version; yet these may be a useful alternative in some instances. Amounts to be fed include those necessary to maintain healthy non-obese body weight. In the case of obese animals, efforts to reduce caloric intake should be made. Home-prepared diets may be a necessary alternative in cases in which response to commercial low-fat diets is unsatisfactory.

## Client Education Points

- Adherence to a low-fat diet, including all foods regularly consumed such as human foods and treats, is required.
- Total caloric intake, even using low-fat foods, should be discussed and alternatives suggested.
- Some cats will refuse fish oil capsules as a treat but will often accept the oil when top-dressed on an existing diet.

## Common Comorbidities

Diseases associated with secondary hyperlipidemias include diabetes mellitus, hyperadrenocorticism, cholestasis, nephrotic syndrome, or may be drug related (megestrol acetate, corticosteroids). Hypertriglyceridemia related to diabetes mellitus can be attributed to decreased lipoprotein lipase activity and decreased clearance from sera or increased production. Hypertriglyceridemia is a risk factor for pancreatitis. Lack of insulin may also stimulate lipolysis and increase cholesterol genesis. Glucocorticoids may also inhibit lipoprotein lipase, reducing triglyceride clearance. Lipemia retinalis may be seen, and cutaneous xanthomas (lipid-laden macrophages under the skin) or thoracic granulomas may be seen with hypercholesterolemia. Peripheral neuropathies (tibial nerve or radial nerve paralysis and Horner's syndrome) may be associated with hypercholesterolemia.

## Interacting Medical Management Strategies

Several drug therapies may be useful in treating hyperlipemias but all may have undesirable side effects or have not been fully explored in cats. Generally, triglyceride concentrations  $<500$  mg/dL need not be treated pharmacologically. **Niacin** (100 mg/day) may reduce fatty acid release from adipocytes with resultant decrease in VLDL synthesis but may result in facial pruritus, erythema, and vomiting. The **fibrate derivatives** stimulate lipoprotein lipase activity and may be used at 10 mg/kg body weight twice daily; however, vomiting and diarrhea may also occur. The **statins** suppress cholesterol synthesis but adverse effects such as lethargy, muscle pain, and elevated liver enzymes may be seen. **Probucol** is a cholesterol-lowering drug but it has been associated with arrhythmias. **Cholestyramine**, a bile acid sequestrant, may be effective in lowering serum cholesterol (1–2 g per os twice a day). Constipation may occur as well as increased VLDL and triglyceride synthesis.

## Monitoring

Monitoring involves serum chemistry determinations including liver enzymes and lipid measurements.

## Algorithm – Nutritional Management of Feline Hyperlipidemia

