

## **The Heart**

**The** feline heart, like the human heart, is a dual pump:

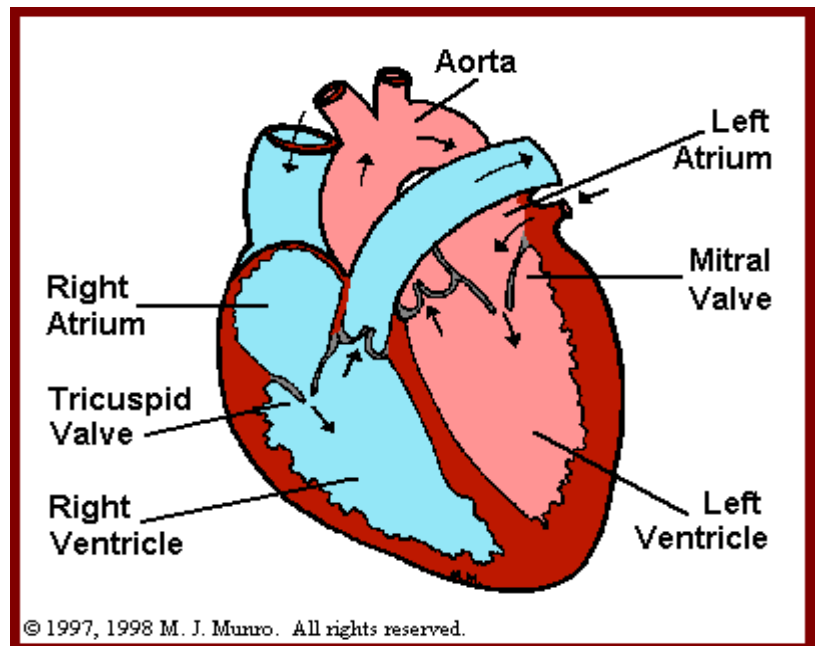
Blood is returned from the cat's circulatory system to the right side of the heart, which pumps it through the pulmonary arteries to the lungs for oxygenation.

The left side of the heart receives the oxygenated blood from the lungs and pumps it into the aorta for circulation throughout the cat's body.

Each side of the heart has an upper chamber, called an atrium, and a lower, main pumping chamber, called a ventricle.

The tricuspid valve prevents blood from flowing backward from the right ventricle to the right atrium when the ventricle contracts. The mitral valve performs the same function on the left side of the heart.

Papillary muscles in the ventricular chambers connect to these valves via string-like fibers called chordae tendineae; these structures prevent the valves from being pushed backward into the atria when the ventricles contract.



## **HCM**

**H**ypertrophic cardiomyopathy is a heart (cardio-) muscle disease (myopathy). The muscular walls of the left ventricle become abnormally thickened (hypertrophy).

The left ventricular walls may hypertrophy secondary to (as the result of) other diseases (e.g., systemic hypertension), or the hypertrophy can be a primary disease in itself.

*Hypertrophic cardiomyopathy* (HCM) is diagnosed when the thickening of the left ventricular walls is not caused by another disease. The papillary muscles may also be enlarged. Papillary muscle enlargement and an abnormality in mitral valve function called systolic anterior motion of the mitral valve may precede, as well as accompany, significant ventricular wall hypertrophy.

As HCM progresses, it can alter the structure of the heart and impair its functioning in several ways:

### **Left ventricle:**

- Ventricular chamber size may be reduced, making it unable to fill with as

much blood

- Ventricular wall stiffness usually increases, which:
  - may impair the ability of the ventricle to relax, which prevents it from filling efficiently
  - may increase pressure in the ventricle during relaxation (diastole), causing blood to back up into the vessels of the lungs and subsequent congestive heart failure (pulmonary edema and/or pleural effusion, i.e., seepage of vascular fluid into the lungs and/or pleural spaces)
  - may cause low frequency vibrations that can be heard as an extra heart sound (a gallop rhythm) in some HCM patients

When the left ventricle is unable to fill with a normal volume of blood, it follows that less than a normal amount of blood is pumped out to the body with each heartbeat. If the blood supply to other vital organs is inadequate, the heart rate may increase as the body attempts to compensate. If the blood flow to the kidneys is sufficiently decreased over time, the release of a hormone that increases blood volume may be stimulated, which in turn can increase the pressures on the left side of the heart and contribute to congestive heart failure.

### ***Left atrium:***

May enlarge due to increased pressures caused by the stiffened left ventricle's inability to fill with a normal volume of blood from the left atrium. Atrial enlargement can slow blood flow, which may in turn cause blood clots to form in the atrium. Clots that find their way into the circulatory system can become lodged in such a way as to block the flow of blood. Rear leg paralysis, a classic example, occurs when a clot lodges where the descending aorta (a major artery) branches to go to the rear legs. This situation is commonly referred to as a saddle thrombus.

### ***Mitral valve:***

- May be pulled forward (systolic anterior motion, or SAM, of the mitral valve) in the left ventricular chamber, possibly obstructing the outflow path to the aorta, which carries blood out of the left ventricle to the body
- May be distorted such that blood is allowed to flow backward, or regurgitate, into the left atrium. When the valve opens during the relaxation phase (diastole) to allow filling of the left ventricle, blood might then be dumped suddenly into the ventricle. This may contribute to the vibrations that cause a gallop rhythm (an extra heart sound).
- Distortions or changes in valve position can cause a systolic heart murmur.

The purpose of this information is to describe feline HCM. It is not intended to be a diagnostic or prognostic tool or to provide medical or treatment advice.

**If your pet is ill, please have it examined by your veterinarian.**

### ***Possible Causes of HCM***

**HCM** is diagnosed when left ventricular hypertrophy is not caused by another disease. Left ventricular hypertrophy similar to HCM may be caused by diseases such as systemic hypertension (most commonly associated with kidney disease) or hyperthyroidism, but such cases cannot properly be termed HCM.

Mutations in several genes have been identified as a major cause of HCM in humans. The mutations known to date are inherited as autosomal dominant traits with variable expression and incomplete penetrance. This means that an abnormal gene from only one parent is needed to cause the disease to develop in the child (and that the child has a 50:50 chance of inheriting that abnormal gene), that its severity can vary, and that it's possible for some people to have an HCM gene mutation but not develop the disease.

The mutations thus far identified for human HCM cause a gene to produce a defective contractile protein. The resultant contractile units (i.e., sarcomeres) within the heart muscle are dysfunctional and so additional contractile units are produced by the myocardium (heart muscle) to compensate. The increased number of contractile units leads to wall thickening.

HCM is most commonly seen in cats less than five years old; however, it is by no means unusual to diagnose primary HCM for the first time in cats as old as seven or eight or even older whose hearts had appeared normal on previous echocardiograms. Familial occurrences have been observed in numerous breeds. While specific feline HCM genetic mutations have not been isolated as yet, its appearance in families of cats, and observations that an affected offspring can be produced if there is an affected parent, strongly indicate a genetic basis. In Maine Coon cats and American Shorthairs, HCM is inherited as an autosomal dominant trait, as it is in humans. In addition, the natural history of the disease and the pathology are the same as in humans. Consequently, it is likely that the disease is caused by a mutation in a contractile protein gene.



To date, no viral or dietary causes of HCM have been identified in humans or animals.

### ***Diagnosing HCM***

**A** cat with HCM may show no clinical signs at all, may show signs of respiratory

distress, or may exhibit severe heart failure, leg paralysis, or even sudden death. Signs such as a mild increase in the respiratory rate can be so subtle that they go unnoticed. Many cats with HCM develop a fast heart rate, and/or a heart murmur, and/or a gallop rhythm (an extra heart sound) as the disease advances. These signs cannot be relied upon, however, to indicate the presence of disease before it becomes severe.

An echocardiogram (ultrasound of the heart) with color flow Doppler imaging is the most conclusive means of diagnosing HCM. An echocardiogram reveals both the physical structure and dynamic functioning of the heart. It is non-invasive and poses essentially no risk to the cat. Electrocardiograms and X-rays may provide your veterinarian with additional useful information, but cannot be used by themselves to arrive at an unequivocal diagnosis. Since the early stages of HCM often only affect the papillary muscles and so can be difficult to recognize, it is strongly recommended that a veterinary cardiologist be consulted for diagnosis as well as subsequent disease management.



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The veterinarian will also perform other tests to determine if the hypertrophy is secondary to (caused by) another illness such as hyperthyroidism or hypertension. If no other causes are found, the cat is diagnosed with HCM.

A cat whose sibling or parent developed HCM may also be at risk for the disease. Periodic echocardiograms might be useful to monitor the status of such a cat. *This could be of particular importance if the cat is in a purebred breeding program*, since one would not want to breed a cat that had HCM. If a purebred cat develops HCM, it is very important that the owner tell the breeder of that cat about the cat's diagnosis.

It is also possible to diagnose HCM at necropsy (veterinary autopsy). Since the heart may contract after death, the clinician should consider various factors such as the size and weight of the heart, the appearance and size of the left atrium, etc., in addition to left ventricular wall thickness. More specifically, HCM can be diagnosed when the left ventricular walls are too thick and the heart weighs more than 20 grams. The left atrium is usually enlarged

### ***Treating HCM***

At present there is, unfortunately, no cure for HCM.

If the cat's heart is hypertrophied as the result of another disease, treatment of the primary disease may result in some improvement of the heart condition.

Hypertrophy affects the heart's ability to function properly. One or more medications may be prescribed in an effort to reduce the risk of serious heart failure and to help the heart function as efficiently as possible. Treatment may also, in some cases, prevent further damage to the muscle of the heart walls.

Treatment options vary depending on the cat's clinical signs and the degree and type of functional impairment resulting from the hypertrophy:

- A heart medication may be prescribed in an effort to improve the heart's performance -- to lessen or compensate for functional impairments that could place the cat at risk for heart failure or blood clots. A common intent of medication is to improve the ability of the left ventricle to fill with blood. In some cases this involves slowing an abnormally fast heart rate; in others, increasing the ability of the heart muscle to relax; in still other cases, a combination of these goals is sought. The goals, and therefore what is prescribed, will depend on the individual cat's situation. Medical opinions may vary regarding the efficacy of the available medications and at which stage a particular medication is most warranted.
- A diuretic may be prescribed if the cat is suffering from congestive heart failure. Treatment does not guarantee that heart failure can be controlled and the heart failure often becomes resistant to treatment over time.
- A medication that reduces the ability of the blood to clot may be prescribed if the cat is felt to be at risk for blood clot formation. The use of certain drugs used for this purpose must be closely monitored to insure the cat is not placed at risk for haemorrhage. Treatment does not guarantee that a clot will not form.

**A** cat that is suffering from severe signs such as heart failure or leg paralysis requires veterinary care as quickly as possible. Ongoing disease management options can be explored when the acute problems have been brought under control.

The veterinarian will want to examine the cat periodically to determine how it is responding to treatment. From time to time these examinations may include tests such as echocardiograms, electrocardiograms, and X-rays. Medication may be adjusted or augmented based on the cat's condition and its response to treatment.

The owner of a cat with HCM should be sensitive to changes in the cat's condition and should not hesitate to seek veterinary advice if the cat seems unwell. The veterinarian may also show the owner how to check the cat's respiration rate, since an increased rate could be a sign that congestive heart failure is developing. The owner should also take note if the cat's sides expand noticeably in and out as it breathes (to a greater than normal extent). Even if the respiration rate seems normal, laboured breathing could also be a sign of heart failure. A cat that exhibits any breathing abnormalities should be seen by a veterinarian.

*Never attempt to medicate your cat without veterinary instruction and supervision!*

Some owners wonder if their cat might benefit from a vitamin or nutritional supplement. Currently, there is no evidence that HCM is the result of any nutritional deficiency. In addition, it is possible that some ingredient in a supplement would be inappropriate either for some aspect of your cat's condition, or in combination with a medication your cat is taking. *Please discuss any questions you might have about your cat's nutrition with your veterinarian.* Inappropriate supplementation could have potentially serious consequences for your pet.

## *Prognosis*

**HCM** is an evily capricious disease. Sometimes it offers no clues to its presence until it's too late for even heroic treatment to be of much help. Sometimes there are signs that all is not well before the disease has progressed too far, but even then it is impossible to predict its course with any certainty.

Some cats may develop only mild hypertrophy and suffer little compromise of heart function, while others progress to more severe disease. HCM may worsen quickly over a period of months; it may progress slowly over several years; its severity may not change for some years and then suddenly worsen -- or it may not. Some cats with HCM may die very suddenly even though they seemed healthy only moments before.

The veterinarian may prescribe one or more medications to manage the cat's condition. Treatment will vary depending on the cat's clinical signs and how HCM has affected the heart. While HCM cannot be cured, medication can improve the heart's ability to function. It may help the cat live longer and more comfortably. The veterinarian will want to re-examine the cat periodically to see if there is any change in its condition and to evaluate whether or not any changes in treatment are needed.

A cat with mild to moderate disease may enjoy an essentially normal life for a number of years. The long-term outlook is more guarded if the cat has more than a mildly enlarged left atrium (a sign of severe disease). Thromboembolism (a blood clot) causes acute pain and severe clinical signs. Although definitive therapy (i.e., treatment to break down or remove the clot) is available, the high recurrence rate of thromboembolism dissuades most veterinarians from attempting this type of therapy. Some cats will break the clot down by themselves and regain limb function over time. However, a cat that has survived a thromboembolism has a significant risk of developing another over the following weeks to months; efforts to prevent their recurrence may not succeed. Severe heart failure may also become difficult to manage over time as the disease progresses. The prognosis for a cat with heart failure, unfortunately, is guarded to poor. Survival, on average, is only a few months.

Your veterinarian can explain the specifics of your cat's condition, the possible treatment options, and their potential outcomes. Don't feel hesitant to ask your veterinarian any questions you might have about your cat's illness. He or she wants to help your cat as much as you do.

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