Here are my kids.

Milo
Teddy
Pope
Capers
George
Chancey
Kris
Some of
Linus
Toume
Rickey
Julee
Bob-husband
Milo
Lucy
(plus a few more)

CARDOLOGY MADE SIMPLE -
WHAT EVERY FERRET OWNER
SHOULD KNOW

This is me. Yes, I’m crazy.

Here’s what you came to learn about!

The term cardiology is derived from the Greek word καρδία (transliterated as kardia and meaning heart or inner self).
What IS cardiology?

**Cardiology** is the branch of internal medicine dealing with disorders of the heart and blood vessels.

The heart is responsible for the circulation of the blood throughout the body – taking poorly oxygenated blood from the tissues and sending it to the lungs; and the well oxygenated blood from the lungs and returning it to the tissues.

Without a properly working heart, the body ceases to function.

Oxygen-poor blood (shown in blue) flows from the body into the right atrium. Blood flows through the right atrium into the right ventricle. The right ventricle pumps the blood to the lungs, where the blood releases waste gases and picks up oxygen. The newly oxygen-rich blood (shown in red) returns to the heart and enters the left atrium. Blood flows through the left atrium into the left ventricle. The left ventricle pumps the oxygen-rich blood to all parts of the body.

Anatomy of the heart

The heart is a very complicated organ. The poorly oxygenated blood from the tissues enters the heart through the vena cava, where it passes into the right atrium, through the tricuspid valve, and into the thin walled right ventricle. It is then pumped into the pulmonary artery and to the lungs, where it picks up oxygen. It returns to the heart through the pulmonary veins into the left atrium, through the mitral valve, and into the left ventricle. The thick walled left ventricle then contracts and pumps the blood into the aorta to be distributed to the body for use.

We need some volunteers!

Midnight on the Yukon River between Whitehorse, YT Canada and Dawson City, YT Canada - seen by canoe in a 460 mile race.
The Right Side of the Heart
(the thin walled side)

- Person on your upper left is the right atrium, receiving poorly oxygenated blood under low pressure from the body via the vena cava.
- Person on your lower left is the right ventricle, receiving the blood from the right atrium and pumping it to the lungs via the pulmonary arteries.

Zachary and Capers

The Left Side of the Heart
(the thick walled side)

- The person on your upper right is the left atrium, receiving oxygenated blood from the lungs.
- The person on your lower right is the left ventricle, receiving blood from the left atrium and pumping blood under high pressure to the body.

Toume

The Heartbeat

- A heartbeat is a two-part pumping action that takes about a half a second. As blood collects in the upper chambers (the right and left atria), the heart's natural pacemaker (the SA node) sends out an electrical signal that causes the atria to contract. This contraction pushes blood through the tricuspid and mitral valves into the resting lower chambers (the right and left ventricles). This part of the two-part pumping phase (the longer of the two) is called **diastole**.
- The second part of the pumping phase begins when the ventricles are full of blood. The electrical signals from the SA node travel along a pathway of cells to the ventricles, causing them to contract. This is called **systole**. As the tricuspid and mitral valves shut tight to prevent a back flow of blood, the pulmonary and aortic valves are pushed open. While blood is pushed from the right ventricle into the lungs to pick up oxygen, oxygen-rich blood flows from the left ventricle to the heart and other parts of the body.

Systole and Diastole

- After blood moves into the pulmonary artery and the aorta, the ventricles relax, and the pulmonary and aortic valves close. The lower pressure in the ventricles causes the tricuspid and mitral valves to open, and the cycle begins again. This series of contractions is repeated over and over again, increasing during times of exertion and decreasing while at rest. The heart normally beats about 100 to 180 times a minute, but this can vary.
Now for the volunteers....

- The atria have received blood – and they need to contract to send it to the ventricles.
- (Upper people squeeze the blood out!)
- The ventricles have the blood – and they need to contract to send it out of the heart and to where it is needed.
- (Lower people squeeze!)

The cycle continues

- Diastole – upper people
- Systole – lower people
- And over and over again!
- As you can see – in heart disease which causes the heart to beat faster – it will tire quickly!

A BIG hand to the volunteers!

Summer says YAY!
(for foamy fries)

This system looks so perfect – what can possibly go wrong?
AN AWFUL LOT!

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When things go wrong, they go REALLY wrong.

That yellow blob would be my lifevest.

Do Ferrets get all these problems?

- Not all of these conditions are commonly seen in the ferret, although they are routinely seen in our other domestic pets.
- Do they not happen, or are we not diagnosing them?

Teddy in his favorite “sofa”

So where do things commonly fail?

- Disorders of the myocardium (muscle of the heart)
- Disorders of the pericardium (outer lining of the heart)
- Disorders of the heart valves
- Disorders of the electrical system of the heart (Cardiac electrophysiology)
- Inflammation and infection of the heart
- Congenital heart disease (birth defects)
- Diseases of blood vessels (Vascular diseases)

What DO we diagnose in ferrets?

- Cardiomyopathy – which means, changes to the muscle of the heart.
- We don’t know why it happens, how to predict it, or how to prevent it.
- We do know that, in cats, it can have genetic factors as well as dietary factors.
- In people, cardiomyopathy may occur as a result of pre-existing endocrine diseases, viral disease, toxicities (including alcoholism), and nutritional deficiency.
Heartworm disease

- Ferrets in heartworm regions of the country (i.e., warm enough for mosquitoes) are susceptible to heartworm disease which can result in severe cardiac disease in the ferret. Because of the relatively small ferret heart, even one or two worms have serious consequences. Treatment of heartworm disease in ferrets is possible but carries a guarded prognosis. Prevention is far better than cure.
- We'll discuss heartworm disease more completely in a little while.

Forms of Cardiomyopathy

- There are 2 forms of cardiomyopathy – dilative, in which the heart thins and enlarges as well as hypertrophic, in which the heart thickens and enlarges.
- Dilative cardiomyopathy appears to be the more common form in ferrets.

Cardiomyopathy

- Cardiomyopathy in the ferret is a frustrating disease because major damage to the heart occurs long before the owner ever realizes that the animal is ill. Cardiomyopathy is caused by the death of cardiac muscle fibers, which are then replaced by the body with scar tissue. Scar tissue does not have the ability to conduct electrical impulse or to contract like heart muscle can. As more and more heart muscle fibers are lost, the heart weakens and can no longer pump blood properly.

Cadiomyopathy, con’t

- Ferrets with cardiomyopathy will have an enlarged heart on x-rays or ultrasound, and may also have blood “back up” as the pump is unable to keep up. This back up can result in fluid pooling either in the abdomen or in the chest. This can cause difficulty breathing and noticeable lethargy.
Congestive Heart Failure

- When the fluid begins to build up in the abdomen and chest, the animal is now in Congestive Heart Failure – a condition in which the heart is functioning too poorly to maintain basic needs.

Lethargy is a major sign associated with heart disease.

Common Signs of Heart Disease

- Coughing
- Lethargy
- Weakness
- Loss of appetite
- Weakness in the hind legs
- Difficulty breathing
- Rapid heart rate
- Rapid breathing

Diagnosing Heart Disease

- Heart disease can be either strikingly simple or incredible complicated to diagnose.
- First always comes a good physical examination.
- Next usually will be radiographs (x-rays) and an EKG (electrocardiograph).
- Often our work up includes blood work and urine as well.
- Most forms of heart disease will involve an echocardiogram (moving/3D picture of the heart)

Radiographs – lateral view

This view shows us the heart, windpipe, lungs, and rib cage. (amongst other things that sometimes should/shouldn’t be present!)
Radiographs – doral/ventral view

This view also shows us the "basics" of the chest, as well as the "mediastinum" – which can be enlarged or widened in some forms of thoracic disease.

Electrocardiograph: EKG or ECG

The EKG shows us a tracing of the electrical activity within the heart.

This shows 2 heart beats

P wave: atrial depolarization
PR interval: time to transverse the AV node
QRS complex: Ventricular depolarization
ST segment: changes with hypoxia
QT interval: total electrical systole
T wave: very variable, minimal use

Echocardiogram

An echo can be used to show a 3-dimensional picture of the heart "in action". The different chambers of the heart can be looked at from different angles, and the valves of the heart can be seen as they open and close. Fluid around the heart can also be seen, as can many masses. Color can even be applied to see the movement of blood through the heart. A good echocardiogram can be invaluable in the diagnosis of heart disease!

Personal bias: echos should only be done by veterinarians extremely familiar with doing them! Echos are as much art and science – and unless the veterinarian is doing them DAILY, the waters become muddier. Seek a boarded cardiologist or radiologist when dealing with echos.

If the good powerpoint karma holds with us – let’s check out an echo!

- http://www.youtube.com/watch?v=7TWuo_Gklzo
Echocardiogram: Example

- Sometimes special testing is required to fine tune a diagnosis – such as color flow doppler (watching the blood actually flow through the heart), bubble studies (watching air flow through the heart), or serial tests (multiple radiographs, echos, or EKG’s).
- Veterinary cardiologists are available to consult with and to perform these advanced tests.

Treatment

- Treatment of cardiomyopathy involves giving diuretics to remove the build up of fluid and to maintain blood volume at an amount that the heart can handle.
- The other staple of therapy as the disease progresses involves medications to strengthen the contractions of the heart – helping the heart to function more efficiently.

Treatment options for cardiomyopathy

- Treatment is similar to the protocol used in people: diuretics (furosemide) to reduce blood volume and fluid buildup, blood vessel relaxers (enalapril) to decrease the heart's workload, agents to enhance heart contraction (digoxin) and drugs to slow down the heart rate (atenolol) and improve function (diltiazem). These drugs are not all used in every case – treatment for heart disease is highly individualized.

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Home Care

- Avoid salt
- Avoid stress
- Avoid heat/humidity
- Remove high energy play opportunities and heavy toys
- Be diligent with meds and other veterinary directions.
- The details DO make a difference in heart disease!

Prognosis

- Long term prognosis for ferrets with dilated cardiomyopathy is guarded. With early diagnosis and proper therapy, many of these ferrets can have a good quality of life for many months. Maintenance of health requires periodic veterinary visits to monitor the heart and adjust drug doses.
- The prognosis for the hypertrophic cardiomyopathy ferrets is not as clear cut. These ferrets may seem totally normal (even to a veterinarian's stethoscope) and then suddenly "crash" or rapidly de-compensate. This is unpredictable but fortunately does not happen often.

Heartworm disease

- Heartworm disease in the domestic ferret is an under-recognized problem. Many veterinarians as well as ferret owners do not know enough about the ferret to understand that ferrets are susceptible to Heartworm Disease.
- Clinical signs include dyspnea (trouble breathing), tachypnea (rapid breathing), poor appetite, heart murmur, fluid in the abdomen or chest, coughing, and sometimes sudden death. Many cases of "unexplained" sudden death in ferrets are heartworm-related.

Heartworm diagnosis

- Heartworm is caused by a parasite, transmitted by mosquitoes, which lives in the heart and lungs of infected animals.
- Diagnosis is made with the IDEXX Snap heartworm antigen test. Ultrasound can be less accurate in that it has produced both false negatives and false positives. The presence of only 1 or a few worms complicates the diagnosis in some animals.

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Heartworm Treatment

- Treatment is only marginally successful. Standard dog therapies are used but survival rates are disappointing. Ferrets are at high risk of sudden death from worm emboli and the survival rate is about fifty percent (50%) with standard therapy.
- Another form of therapy is available for treatment of heartworms in ferrets. It was off the market but has recently been re-introduced. In the dog, it does not have the capability to kill adult worms at the recommended dose. It does, however, kill all larval stages of the worm. Since adult heartworms in ferrets tend to be stunted and do not achieve the size and reproductive ability they do in dogs, this may make them more susceptible to the drug in the ferret.

Heartworm Prevention

- Prevention is the preferred method of dealing with heartworm in ferrets. It is important to stress that living indoors in endemic areas does not eliminate the need for administration of heartworm preventive. Many cases of heartworm disease have occurred in ferrets that have seldom or never been outdoors.
- Common medications for prevention include: Heartguard, Interceptor, and Revolution – all of which should be used monthly during the heartworm season (typically late summer through the fall months).

An ounce of prevention is worth a pound of cure!

Any Questions?