

# Feline Murmurs, Gallops, & Dysrhythmias: When Should I Investigate/Refer?

Kerry Rolph, BVM&S, CertVC, PhD, FANZCVS (Feline Chapter), DipECVIM-Ca, FRCVS discusses auscultable cardiac abnormalities, addresses their significance, and gives some practical guidance on diagnostics and management.

## Speaker Bio:

Kerry Rolph, BVM&S, CertVC, PhD, FANZCVS (Feline Chapter), DipECVIM-Ca, FRCVS graduated from Edinburgh University and worked in small animal practice for two years before returning to Edinburgh. She gained her certificate in Veterinary Cardiology and her PhD in 2004. She passed her Feline Medicine Australian College of Veterinary Scientists Fellowship examinations in 2010. Gaining this diploma level qualification made her eligible to apply for Specialist status with the Royal College of Veterinary Surgeons. In 2014 Kerry gained her European diploma in Companion Animal Medicine and became a European Specialist. She then worked at a private referral hospital in Bristol for 3 years before joining Ross University School of Veterinary Medicine (RUSVM) in January 2019 as an associate professor. In 2020, Kerry was awarded Fellowship of the Royal College of Veterinary Surgeons.

## Learning Objectives:

1. Identify causes, possible investigations, and treatment options pertaining to murmurs, with attention to owner communication
2. Recall the potential for sudden decompensation in murmur patients, and how the safety of transportation can be increased
3. Recall the significance of gallop sounds and the potential differentials for gallops
4. Differentiate between the causes and significance of sinus arrhythmia and dysrhythmias in cats, with attention to prioritizing the subsequent approach

## Feline Murmurs, Gallops, & Dysrhythmias: When Should I Investigate/Refer?

---



*Dr. Kerry Rolph, BVM&S, CertVC, PhD  
FANZCVS (Feline Chapter), DipECVIM-Ca, FRCVS*

Hi. My name is Dr. Kerry Rolph. I'm from the UK, as you can probably tell. I qualified from Edinburgh vet school. I went into general practice for a couple of years before going back and studying for a PhD in cardiology. And then, I went on and did my Australian membership and then fellowship in Feline Medicine. That's actually the only residency-based feline medicine specialty exam left in the world. I'm not Australian, although a lot of people do confuse my accent. And then I went back, and I did my small animal internal medicine, so I have a very mixed background. I teach Small Animal Internal Medicine at Ross University, and I'm a fellow at the Royal College of Surgeons. And so today, I want to talk about feline heart disease and the things that we may find on physical exam. And what they can mean, and when we should choose to do investigations or refer these patients.

Program VetPrep

- **Feline murmurs**
  - Why do they come and go?
  - Is grade important?
  - How do I explain this to the owner?
  - When should I investigate/refer?
- **What is a gallop and when should I worry?**
  - If I'm going to refer, how do I ascertain if the cat is fit to travel?
- **It's not regular!**
  - Sinus arrhythmia in the cat
  - Dysrhythmias in cats-causes and significance

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So really looking at murmurs, gallops, and dysrhythmias. And I'm probably going to spend the most amount of time talking about murmurs because these are incredibly common and quite complicated. Just to run through, when we're talking about murmurs, I want to be looking at why murmurs can come and go in cats, what's going on there. And we have a little bit of a think about grade of murmurs. We don't really talk about the shape of murmurs in cats so much, but is grade even important. And how do we explain what's going on to the owner and when we should investigate or refer And then I'll go on and talk about gallop science, and when you should be worried about them. And if you're going to refer what to think about prior to referral – is the cat fit to travel, and then dysrhythmias, what different dysrhythmias can mean in the cat. But before we just start on murmurs, obviously, we would be able to auscultate them.

# Murmurs

---




Feline Murmurs, Gallops, & Dysrhythmias

Feline Murmurs VetPrep

● **Auscultation Tips and Tricks!**

- Chose the right tools!




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

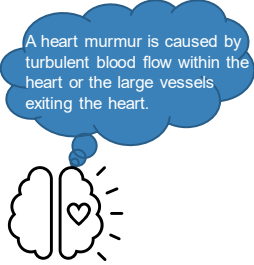
And so just to think about the cat and what's different about the cat and feline auscultation, what we need to be considering. So one thing that I will always do when auscultating a cat is use a small head of the stethoscope. So using a stethoscope either with a dual head, that one side is small and one side is larger, or a neonatal or pediatric Littmann stethoscope, my preferences. I do have an electronic stethoscope, which has a very large head. But it does record sounds over the entirety of that head. And if we have a small head stethoscope, it helps us be able to pinpoint whereabouts we're hearing abnormalities. Just remembering if we hear a murmur, it's actually caused by turbulence in the blood. And that turbulence could be within the heart or within the large vessels exiting the heart. And that's how I explain it to an owner, well, what a murmur is is just this turbulence in the blood that we hear. But how do we make sure that we're hearing it? How do we make sure that we're putting together the picture of what we find on our physical exam and being able to interpret that and give the owner the best advice as to what we should do with a cat with a heart abnormality.

Feline Murmurs
VetPrep

● **Auscultation Tips and Tricks!**

- Start by palpating and compressing the thorax





A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

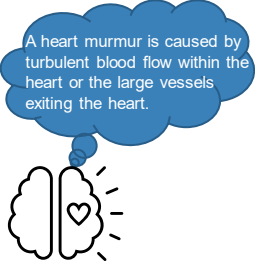
Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

Well, for me, auscultation of the thorax actually has four parts, so it's not-- sorry, examination of the thorax actually has four parts. It's not just auscultation. We want to start by palpating and compressing the thorax, and that means feeling down the thoracic wall, noticing where the apex beat is. Is it where it should be? Or has it been pushed caudally or somewhere very strange. If it is in the wrong place, then there's probably something quite large in there that's pushed up way. So that would imply that there is either a lung lobe torsion or a lung lobe consolidation or most likely a mass within that thorax. Does the thoracic cavity feel normal? Have we gotten any heave lines? Is it normal shape, or have we got a barrel chest? Heave lines and barrel chest appearance are things we're going to see with chronic respiratory or chronic dyspnea. And so if we think about diseases that are most likely to cause chronic respiratory signs, that's our asthmatic cats. So certainly-- if we're feeling those, we're going to thinking this is probably less likely cardiac. Is the cat coughing. Coughing is less like to be cardiac. It's more likely to be respiratory in origin. So feel over the thorax. See if it feels normal. See if it compresses normally. The thorax of a young cat should be nice and springy, and it will be springy until they get ossification of the costochondral junctions, which occurs when they're around about 14, 15 years of age. So if they're an older cat, then no. They're not going to have a nice, springy thorax, but a young cat should have a really good compression. If it doesn't compress properly, again, there's a likelihood that there's something in there that shouldn't be, be it fluid, too much air and a pneumothorax, a soft tissue mass, or a soft tissue density such as consolidation of the lungs

Feline Murmurs VetPrep

● **Auscultation Tips and Tricks!**

- Auscultation



A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

Once I've done that, obviously, we're going to think about auscultation. And auscultating the cat, it's incredibly important that we listen down on the sternum. If you think about how the heart lies. Just think about an older cat's radiographs or cats' radiographs in general. The heart is far more sternal. And as they get older, it gets more and more sternal. So we're listening down on the sternum, and that's actually where we're going to hear the majority of our heart murmurs in cat. So it's really important that you're listening right down underneath the cat. And as you heard from teachers at the vet school, the cat really should be standing up for auscultation. But in the consult, they never are. Sometimes they're sat down. Then you can get right under, and you can still hear those heart sound very, very well. And if you stand the cat up for the entire thoracic examination, you only really find that those very well-behaved cats will tolerate that. So I will often listen with them standing for a moment, and then let them sit down and continue auscultating the thorax.

Feline Murmurs
VetPrep

● **Auscultation Tips and Tricks!**

- Auscultation: How to deal with purring!!





A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

If they are purring when we try and auscultate their chest, we can't always hear things properly. You might not be able to hear the heart properly, and you certainly won't be able to hear the lungs very well. So there are some things that we can do. If they're very wriggly, we might not be able to hear very well. So with the stethoscope in my ears, I'll often pick the cat up.

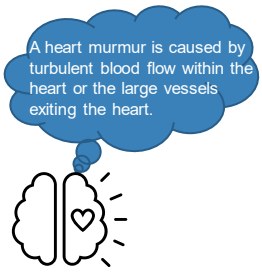
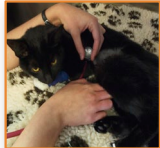
Now, a lot of cats don't really like being picked up. But if they're a very sweet cat and they're purring a lot, that often just stops them. And they'll look around and think, what on Earth is going on? Why is this vet carrying me anywhere? And then if you've got your stethoscope already down on the sternum, it means you can have a really good listen around there. In some cats, that even isn't enough, and you can try and distract them by making noises. But one thing that is particularly useful if their purring is to go and turn on a tap. Oh, when tap turns on, just be careful that they don't make a bee line over your shoulder and scratch you lots. But if you turn the tap on nice and slowly, they're often like, I really don't want to be dunked in that water. Thank you. And they stop purring, so that can be incredibly useful. Also, when we're listening to a cat's heart, it can be useful to have them beginning of the physical exam nice, a relatively slow heart rate because we've got a nice cat-friendly practice, and they're relaxed. But we also like to have what's called provocative auscultation, where we put the heart rate up a little bit. And things like picking them up, taking them to a tap can also speed up that heart rate. And we can listen. There are some murmurs that you will only hear at high heart rates, or it will get worse at higher rates and then calm down at lower heart rates. So it is useful to listen for a while through those changes in heart rate to see if a murmur arises.



Feline Murmurs VetPrep

● **Auscultation Tips and Tricks!**

- Auscultation: The cardiac rhythm should be noted and the cat should be assessed for pulse deficits by palpation of the femoral pulse at the same time as auscultating the heart



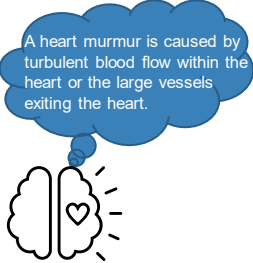

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

Obviously, when we are auscultating, we want to take-- pay attention to the rhythm, and see if we have any abnormalities in the rhythm, if we've got any a pulse deficits.

Feline Murmurs VetPrep

● **Auscultation Tips and Tricks!**

- The timing and quality of a peripheral pulse should be assessed



A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

You could feel for femoral pulse at the same time as auscultating and also check the cardiac output and making sure we have adequate circulating volume, so checking those peripheral pulses just alongside. And most cats will actually allow you to check for a peripheral pulse without even really noticing what you're doing. So I'll often to do it while I'm talking to them, and I'm just stroking them. I just have a quick feel on peripheral pulse. Oftentimes, I'll just do the forelimb just like you'd be checking your blood pressure, have a quick feel there. And make sure that they have adequate pulse quality.

Feline Murmurs VetPrep

- **Auscultation Tips and Tricks!**
  - The jugular should be inspected for signs of distension or pulsation, as when present, these may indicate increased right atrial pressure, or pleural effusion



A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

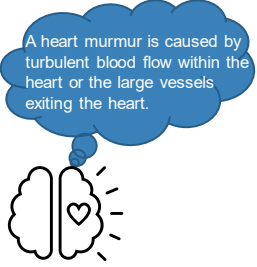

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

For the cardiac or cardiovascular system, we also want to make sure that we assess the jugular. And you might do this in a consult, or if you're taking bloods or doing investigations, if you've heard an abnormality and you want to have a little bit of a closer look, then clip up the neck and just have a look at the jugular and see if there's any abnormalities such as a distended jugular or a pulsatile jugular that could indicate that you've got increases in the right atrial pressure or a pleural effusion going on.

Feline Murmurs VetPrep

● **Auscultation Tips and Tricks!**

- Auscultation: A four-quadrant approach should be used to assess the lung fields and the location of any adventitious lung sounds should be noted



A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.


Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

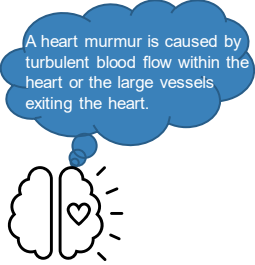
And obviously, alongside auscultating the heart, we want to make sure we listen to those lung fields, a really good listen for any adventitious lung sounds. If you find any wheezes, any crackles, any of those abnormalities occur in there.

Feline Murmurs
VetPrep

● **Tips and Tricks!**

- The thorax should be resonant when percussed over the lung fields
- Increased resonance can occur with air trapping
- Decreased resonance can occur with fluid or soft tissue masses within the thoracic cavity





A heart murmur is caused by turbulent blood flow within the heart or the large vessels exiting the heart.

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

Once I've auscultated the thorax, I will also percuss the thorax. And the thorax should be like a drum, and it should have a really good resonance. So when we percuss it, we should be able to hear that drum-like sound, and we can compare one side to the other and just make sure that there's no line where things become dull after. I do this in all cases, so you'll get very used to what's normal. If you go at the heart, it will become dull. If you go to the liver, it will become dull. But by percussing, we can see if there's increased density. If there's a decreased resonance, we've got either fluid in there or a soft tissue mass in there. If there's increased resonance, we've got either air trapping or pneumothorax. And by looking at the respiratory pattern, listening to the heart, percussing, compressing, and palpating the thorax, we can actually do a lot to narrow down our differentials. And I talk about this at length in a lecture I did on the dyspneic cat that's available from VetPrep as well. So do make sure you're percussing the chest. It's such a useful tool in cats, and I really can't encourage you to do it enough, because there are so many cases you will pick up abnormalities then.

Feline Murmurs VetPrep

- Many conditions can result in a heart murmur, including:
  - Primary cardiomyopathy (i.e. HCM, RCM, DCM, UCM)
  - Secondary cardiomyopathies (i.e. thyrotoxic cardiomyopathy, hypertension)
  - Congenital heart disease (i.e. VSD, AV valve dysplasia, severe ASD, PDA)
  - Heartworm disease
  - Anemia
  - Myocarditis/endomyocarditis - rare
  - Infiltrative disease (i.e. lymphoma) - rare

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

OK, so we've gone through thoracic examination, we've got a cat with us, and we've heard a heart murmur. And then we have to decide what that means, whether we need to investigate it, or not. Well there are lots of different things that can cause a heart murmur. And if we have a significant heart murmur, it may be that they have acquired the cardiomyopathy. We know that hypertrophic cardiomyopathy is very common in cats, and an awful lot of cats will have cardiac hypertrophy. But we also see restrictive cardiomyopathy, dilated cardiomyopathy, and those cats that swim between two of these that it is just hard to place in a group, so some people call them unclassified cardiomyopathies. In older cats, we see a lot of secondary cardiomyopathy, so hyperthyroidism will actually alter the ratio of fast myosin fibers within the heart, and it will contract more rapidly than normal. So, it actually has increased systolic function early on, and that increased systolic function leads to hypertrophy, bit like an athlete's heart, but with that hypertrophy, is increased oxygen consumption, and the coronary arteries can't keep up with that, so you get small areas of infarction, and ultimately you can end up with a ventricle that fails. So a thyrotoxic cardiomyopathy can be very significant. Hypertension, having to beat against a high blood pressure is going to make that muscle thicken, and can lead to secondary cardiac disease. And we want to make sure that we're picking these up, because especially early on, they are potentially reversible cardiac diseases. And in medicine, we don't get to cure things very often, so if we cure this heart disease, then that's great. It's the surgeons that usually get to cure things unfortunately. What about congenital heart disease? Actually congenital heart disease is a lot more common in cats than people realize, is found at post-mortem more regularly than it is diagnosed, because oftentimes it is clinically silent, or at least quiet. So until things get quite bad, you might not see any clear signs. The most common congenital heart diseases are ventricular septal defects, and atrial septal defects, that's in post-mortem studies, because the atrial septal defects often don't cause any clinical signs or issues. But cats also got quite a lot of AV valve dysplasia, we can see signs that they have a very large atrial septal defect, and they obviously get patent ductus arteriosus the same as dogs. In fact, they get all the same congenital abnormalities, it's just that the distribution of cases is quite different. Pulmonic stenosis, for example, is actually quite rare in cats. Heartworm disease obviously a differential if you're in a heartworm endemic area. Other things can lead to heart murmurs - anemia. Anemia ultimately can lead to heart failure, so if you have a pet case that's anemic, you can't necessarily presume that it's heart murmur is just due to the operation in the biological properties of the blood. In other words, it's more

watery, so it's down to leak through valves more. It may be, because the heart is having to pump faster, because the blood isn't carrying as much oxygen, and the muscle isn't being oxygenated as well, it can fatigue and you can see congestive heart failure there. And then infectious causes such as myocarditis, endomyocarditis, and infiltrative diseases such as lymphoma could all be causes of murmurs. So we have a lot of different things that can cause heart murmur in cats.

Feline Murmurs
VetPrep

● I found a murmur!! What does it mean?

- Is it systolic or diastolic?
  - Diastolic murmurs are rare and are generally associated with severe or congenital heart disease. Therefore, a diastolic or continuous murmur should always be investigated.

Diastolic Murmurs

Continuous Murmurs

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

But when we find a murmur, first of all, we have to work out what does it mean. Is it likely to be associated with one of these significant diseases? Or may it be a relatively benign disease process? Well, first things first. Is it systolic or diastolic? And when we listen to a murmur, 99% of the time they're going to be systolic, and that's what our brain has got used to hearing. And cats heart rates are very high obviously, often when they're coming in for a heart rate in the exam of 160 to 180 beats per minute if you've got a cat friendly practice. If you don't have a cat friendly it can be even higher. And working out if it is systolic, or diastolic sounds like it's going to be hard. Actually, when you hear a diastolic murmur, they sound really weird. So you put the stethoscope on, and just like what on earth is going on? And then just take a second, OK. And listen lub dub, lub dub, lub dub, and it's going to sound so foreign to you that it will actually stand out, but it's a strange sounding murmur. If you hear something that sounds really sort of out of place, just say, OK, what is the timing? Could this be diastolic? And the chances are that if you've had a really strange murmur, it could be diastolic. The other type of murmur can hear that's not systolic alone is a continuous murmur, and a continuous murmur will have a systolic and diastolic component of [HEART SOUNDS]. Sounds like a wood saw. If you hear that, or a diastolic murmur, start thinking about the differentials. And realistically, that in very simple terms, differentials are congenital disease, usually severe congenital disease. So typically communication between the oxygenated, and deoxygenated blood somewhere, or congenital valvular deformed, or issues, or very severe cardiac problems. And so if you hear one of these diastolic, or continuous murmurs, yes, that case requires investigation. But as I say, they are not our most common. [HEART MURMUR] OK, that's a diastolic murmur, so it's slowed down, it is not a cat, it's actually human diastolic murmur, just to give you an example of being able to hear it in a cat. As I say, they are really quite something to get your head around. [HEART MURMUR] And that's a continuous murmur caused by a patent ductus arteriosus.



Feline Murmurs
VetPrep

● I found a murmur!! What does it mean?

- Where is it located?
  - The origin of the murmur should also be noted. The majority of murmurs in cats are parasternal in origin (typically systolic murmurs). In this location the outflow tract and AV valve murmurs can be auscultated.

Systolic Murmurs

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

But the majority of our murmurs are going to be systolic in origin, and in dogs you've got used to describing different shapes of systolic murmurs, in cats, we really don't describe all these different shapes, because they are so fast, you're just going to say systolic murmur. The next thing is the point of maximum intensity. We're all taught the point of maximum intensity. Well, yet we should note the origin of the murmur, but in most cats, that's actually going to be sternal, or parasternal, and it's a little bit unfortunate that we actually hear the outflow tract and our AV murmurs all down on the sternum. So it may be at the front of the sternum, and you think, well, it's more likely to be outflow tract than AV valve, but it can be quite hard to know. So oftentimes, we sort of cranial sternum, left edge of the sternum when we're describing the origin of the murmur in cats. [HEART MURMUR] And that is a nice feline systolic murmur auscultated right down on the sternum. OK, so, if we want to think about that murmur that we just heard, we're going to not only say where we've heard it, we're also going to say what grade it is.

Feline Murmurs
VetPrep

● Is grade important?

| Murmur grade | Description   |
|--------------|---|
| I            | Audible in a localized area, only after prolonged listening with a stethoscope  |
| II           | Immediately audible; not as loud as the heart sounds  |
| III          | Immediately audible; of equal intensity to the heart sounds   |
| IV           | Immediately audible; louder than the heart sounds; no precordial thrill (palpable vibration evident over the heart)                         |
| V            | Easily audible and associated with a precordial thrill; audible only when the stethoscope is in contact with held against the thoracic wall |
| VI           | Easily audible with a precordial thrill; can be auscultated with the stethoscope lifted off the thoracic wall                               |

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

And it sort of leads to the question, is grade important? And certainly when your used to dogs, your used to gradeing. And grade actually really gives you quite a good idea of what's going on to some extent in canine cardiology. Well, a cat heart murmur that's very hard to hear that's audible just in one localized area, and you have to listen for a long time. So it's going to be a grade 1. People find cat heart murmurs at grade 1 very hard. And as I say my, PhD was feline cardiology, I listened to thousands of cats' hearts, and we still have debates about whether that was a grade one murmur there, or not sometimes. So they are hard to hear. If you have an electronic stethoscope you can actually play it out afterwards and have a look, and then you get used to picking them up, but a lot of cats will have that. Grade two murmur, it's very, very common. These are immediately audible, but in a localized area, and they are not as loud as the heart sounds. Great 3 is immediately audible, and of equal intensity to the heart sounds. So the murmur that we just heard, was a great 3 murmur. A grade 4 is immediately audible, it's louder than the heart sounds, there is no thrill palpable, and you can hear it often over a wide area of the thorax around the sternum. Grade 5 is easily audible, and you can feel a thrill. When put your hand on the thoracic wall, you will feel the vibration. A grade 6 is easily audible, and you can feel a thrill, but you can actually take the stethoscope off the thoracic wall, and you can still hear that there's a murmur there. OK. So we do grade feline thoracic murmurs, and we will think about what that grade means.

Feline Murmurs
VetPrep

● **Is grade important?**

- Yes, and no!
  - The grade of a heart murmur does not correlate well with the degree of severity of the heart problem, nor does the absence of a murmur rule out significant heart disease
  - High grade murmurs (i.e. V or VI) are more likely to be significant
  - Low grade may or may not be; look for clinical signs, and assess if it's dynamic


Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

However, in answer to the question, is grade important? Yes it is, and no, it's not. So what do we know? Well, we know that the grade of the murmur does not correlate well with the degree of the severity of the heart problem, or help you narrow down your differentials, and not having a murmur doesn't rule out significant heart disease. So, for example, if we think about the presentation that's probably the worst form of presentation we can see, cats with aortic thromboembolism, some studies have shown that between 30 and 43% of cats that present with aortic thromboembolism do not have a murmur. Some of those cases would have had a murmur auscultated at some point in the past, but not all of them. And I can remember one little cat, a Devon Rex that came in, and we knew that he had hypertrophic cardiomyopathy, he had severe hypertrophic cardiomyopathy, he had congestive-- had had congestive heart failure previously and was on medication. And he came in with aortic thromboembolism, and I have recordings of his heart and he has not got a murmur. Why didn't he have a murmur? Because actually what he'd done, is he ruptured his left atrium, he had some pericardial fluid, which was sort of stopping us hearing very well, he had a blood clot sort of half closing the hole to the left atrium, and his heart muscle was not contracting particularly well. So he'd gone into systolic failure. And because his heart muscle is not contracting as firmly as normal, he wasn't getting the normal turbulence of the blood. The pump was decreased. And when you get pump failure, and you get a decreased contractility of that heart, you might not be able to hear the turbulence anymore. And so in a cat that has a critical presentation, and they've gone into congestive heart failure, sometimes you're not going to be able to hear a murmur. In cats particularly with dilated cardiomyopathy, or restrictive cardiomyopathy, unless you've got valve leakage, you're not going to necessarily have turbulence there. It doesn't tell you how well that heart is working. Now, remember it is turbulence within the blood. And for turbulence, you've got to have a pumping effect, but you've also got to have either a narrowing, or a leaking within the heart itself, or the vessels. If we have a high grade murmur, a grade five, or six, that's highly likely to be significant, as probably the times you see those most commonly are actually congenital defects, where you've got mixing of quite a large pool of blood. Grade 4 would certainly raise a suspicion with me that it may be significant. Grades one, two, or three may or may not be significant, and really to interpret those, you are going to be looking for other clinical signs that would raise our index of suspicion that this is cardiac, and we also want to assess and see whether this is a dynamic murmur or not.

Feline Murmurs
VetPrep

● **Clinical Signs of Heart Disease**

- Dyspnea
- Lethargy
- Inappetence/anorexia
- Vomiting
- Ascites
- Edema
- Cachexia
- Syncope
- Limb paralysis/paresis
- Collapse
- Cyanosis
- Cough (very rarely associated with cardiac disease)



Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

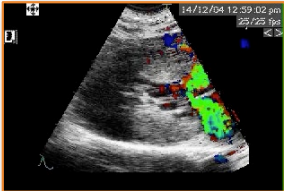
OK, so I just want to go and sort of explain what I mean by those two things. Firstly, clinical signs. What clinical signs can we see in cats with heart disease? Well, dyspnea is a big one. We can occasionally have lethargy or inappetence. So they're not typically really ill, unless they've got something like inflammatory cardiac disease or endomyocarditis, but they just might not have quite good normal levels of energy. Inappetence, anorexia, and vomiting are actually common. 40% of cats with congestive heart failure will have a history of vomiting. We can see ascites in some cases, it is relatively rare in cats with heart disease. We can get edema, and certainly pulmonary edema will occur in about 33% of cats with congestive heart failure, pleural effusion will occur in about 35% of cats with congestive heart failure, and both pulmonary edema, and pleural effusion will be present in the rest. So certainly we can get edema of the lungs, but we can get peripheral edema in occasional cases as well. It has been going on for a long period of time, we can see cachexia. Syncope is something we don't get cats presenting for very often, but when you have a case it's got cardiac disease, if you ask the owner specifically, if you have ever seen your cat suddenly collapse, it's crazy to me the number of owners that say yes. And it's something that owners don't-- the cat will have collapsed, and then literally just a second. So they get back up. And the owners don't think anything of it. And so they don't actually come in. So whether they're syncopalepisodes, or whether they're just collapsed, it's hard to know. Sometimes when that happens a cat even vocalizes. And whether they're actually having an infarct at that point, a heart attack, is really hard to know, and I was taught at that school that cats don't have a heart attack, they don't get the same conditions as people. Actually when we look at the myocardium when they have hypertrophy there are frequently infarcted areas. Obviously, we can see limb paralysis, or paresis if we have aortic thromboembolism occurring, we may see cyanosis more likely to occur in congenital heart disease, and I put it on the bottom here as being very rarely associated with cardiac disease. Realistically in the thousands, and thousands of cats I've seen with congestive heart failure, I've only ever had two that have come in with a history of coughing, and I think they're more likely to be vomiting than coughing. So although some people will put cough as a sign of heart disease, realistically it is incredibly unlikely if the cat comes in coughing that they have just heart disease. Often they may have concurrent bronchopneumonia, and endocarditis, or something like that if they're coughing.

So if you see something that's unusual, you take photos. And this is Mia, and she's modeling some of the unusual causes or the clinical signs of heart disease. So Mia was, at this point she was a 19-year-old Devon Rex, you can see she is emaciated. Every bone along on her back was palpable, she had been for about four years, and she came into our first opinion service at Edinburgh, and they immediately referred her internally to me for a cardiac assessment. She's got ascites, and you can see the little baggy bits, she's got baggy trousers on as well. So she's got peripheral edema. She had a heart murmur, she had a gallop, she had a dysrhythmia, she was in congestive heart failure. I recommended that she start on furosemide straightaway. The owner wasn't ready for this. She hadn't been to the vet's for a long time, and she wasn't sort of accepting that Mia was really quite unwell. So she discharged Mia, and took her to another practice in Edinburgh, who took one look at Mia and said, "Oh, she should be referred to Kerry at the vet school!" She came in to see me as a referral case then, and then had furosemide at four times the price, because then she was a referral case. But ultimately Mia did very well. She responded to the furosemide, and she actually lived for another two years despite her congestive heart failure.

Feline Murmurs
VetPrep

● Why does the murmur come and go?

- In cats with HOCM there are 2 murmurs
- Outflow tract murmurs depend on the velocity and therefore the heart rate
- Therefore, the grade of a murmur can change dependent on the contribution of the outflow tract turbulence



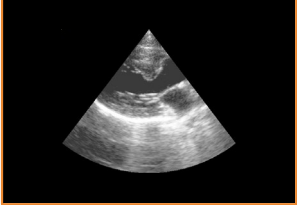
Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

If we have a case that has some of these signs, they're mild, and they've got a murmur that's coming and going, does it necessarily mean that is an important murmur? Well, there's a couple of reasons why feline murmurs can come and go. And this is usually that it's getting louder, and quieter as the heart rate goes up, and then comes back down. And if you have a murmur that's when the heart rate's like-- say the heart rate's 160, and they hear a dog bark, or you turn the tap on, and a heart rate goes up to 200. And it goes from grade three murmur, up to a grade four murmur, and then back, or even a grade two murmur, to grade four and then back. The likelihood of what's happening, is that they have hypertrophic obstructive cardiomyopathy, because in this condition, there's actually two murmurs that are occurring on top of each other, and you can't distinguish them when you're hearing. So if we have hypertrophic cardiomyopathy, we've got thickening of the heart muscle. If we have hypertrophic obstructive cardiomyopathy, that thickening is often affecting the interventricular septum, and causing some turbulence as the blood has to flow past a slight narrowing in the outflow tract. As the blood is turbulent, what it can do is cause the septal leaflet of the mitral valve to get sucked up into that turbulent flow, and we end up with systolic anterior motion of the mitral valve, flow of blood through that leaking mitral valve, and also out certain turbulence in their outflow tract. So these cats actually have left ventricular outflow tract turbulence, and a leaking mitral valve, because of the hypertrophic obstructive cardiomyopathy. Now, when you have an obstruction in the outflow tract, if the heart rate slows down, the narrowing isn't going to be so important dynamically, and we're not going to see so much turbulence. So if we slow down the heart rate, the blood turbulence will be decreased, the flow velocity will be decreased, and then a murmur grade will be decreased. And so, we know that, for example, if you give an alpha two to a cat with outflow tract turbulence, you can get rid of that murmur, because the heart rate slows down so much. Not so recommend you do that. So that's one reason why a cat with a murmur that is there, can get worse with provocative testing and then get better. Some cats will actually have very loud murmur when they have a lot of turbulence there. So don't be fooled even if it goes up sort of grade five, and goes back down. It could still be hypertrophic obstructive cardiomyopathy. OK.

Feline Murmurs
VetPrep

● Why does the murmur come and go?

- In many cats a lone area of localized septal hypertrophy exists
- This causes narrowing in either the left or right ventricular outflow tract
- At low heart rates there is minimal turbulence and no murmur
- As the heart rate increases (provocation) we hear a murmur associated with outflow tract turbulence



Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.


Then we have these irksome cases where you listen to them one day, their heart rate was slow, there was no murmur there, and then something happens, and/or it's another vet, another day, the heart rate's high, and then suddenly got a murmur. And so you go from no murmur, to a murmur. What do these cats mean? Well, we have what's called a basilar septal bulge or a lone area of localized septal hypertrophy in many cats. And this is a nice example of it. So we've got a ventricle here. This is our left ventricle posterior wall into ventricle the septum. This is our outflow tract, and we've optimized the image to look at the outflow tract. This is our mitral valve here, and left atrium. And you can see the top of this interventricular septum has got a lump on it. And that lump causes some narrowing. So instead of being able to go through a nice wide river here, it's going to go through this narrowing, before goes up to the heart. When we get a narrowing, we will get turbulence occurring. And so, as the blood goes round here, we can get some turbulence, and the higher the heart rate, the greater the turbulence, and it can put it over the speed that we can start to hear murmur. So we will start to hear murmur if they've velocity in the outflow tract is much over about 1.2 meters per second. And then we'll start to hear a murmur. The question is, is this normal or not? And this is actually something that I first described when I was doing my PhD, because I was looking for normal cats. And I was recruiting cats over the age of eight, and performing ultrasounds on them. And so many times when I would try to recruit normal cats for my control group, I would listen to them and they'd have a murmur. And so our group had started discussing this, a group in London actually wrote a paper looking at cats just coming in for vaccination, and they'd auscultate them, and then they would speed up their heart rate, and re-auscultate them. And 40% of normal cats can have a heart murmur. They were presenting clinically healthy, no problems, and with provocative testing, they were getting heart murmurs in up to 40%. So this was a problem I was having to find normal cats for my PhD, actually and then I was scanning, and I was finding this problem so frequently. And so when we see something like that, we go to the human literature, and we try and find out if this is reported in another species, what's potentially going on. And people can have this. And obviously, we have a condition that causes thickening of the heart muscle in cats called hypertrophic cardiomyopathy. And the big question is, is this a form of localized hypertrophy, and a type of hypertrophic cardiomyopathy? Or is it a normal finding in cats? And so, we don't know the causes of hypertrophic cardiomyopathy in many cats. We know that in some breeds, there's a genetic mutation, but we've only found a couple of mutations, whereas in

people they know hundreds of mutations. So, how do they interpret this in people? Well, the problem is they still don't know. 50% of people with this have a genetic mutation which could predispose them to hypertrophic cardiomyopathy, and 50% do not have a known mutation. But this is the most common area to see the classic pathological changes for hypertrophic cardiomyopathy. So is it a disease process? Or is it normal? We don't know. It is almost normal, because it's so commonly found. But we still are not sure whether it's disease process. Does it progress? Because if it is a disease process, but it's such a benign disease process that it doesn't progress, doesn't cause any problems, we don't need to worry about it. And the evidence we have is, if it progresses at all, it is incredibly slowly. So whether it's truly a disease, or not, it does seem to be relatively benign. So if you have a cat that doesn't have a murmur, but only gets a dynamic murmur, it's most likely that it's outflow tract turbulence, this can affect the left or the right side. And then you may need to think about what may be causing that. But oftentimes it is times it is just this localized area of hypertrophy, but whether it's a disease or not, doesn't seem to be progressing in the majority of cases. Obviously if that moment changes, it's there all the time, then that would be a time I would start saying to the owner, It's time to investigate.



Feline Murmurs VetPrep

- Why does the murmur come and go?
  - 15.5-44% of apparently healthy cats have murmurs
  - When these cats are assessed 22-88% have cardiomyopathy or congenital heart disease
  - There is a small proportion of cats with heart murmurs in which no underlying cause could be found



Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So this is difficult to explain to the owner, but we know that in studies between 15.5 %, and 44% of apparently healthy cats, will have a heart murmur, the high numbers are worth provocative testing. And if we take those cats that have got murmurs, and we assess them, we do investigation, we can find abnormalities in between 22 and 88%, depending on whether you assess this area within the ventricular septum. Yes a proportion of these apparently healthy cats will have a primary cardiomyopathy such as generalized hypertrophy, and some will have congenital disease. At the very occasional case where you can't find an abnormality, and therefore you'll hear about physiological murmurs in cats, whether these truly exist, or whether there's just a very subtle area of thickening that we're not picking up on ultrasound, we're not entirely sure, but certainly they don't seem to be a problem clinically throughout the cat's life. But the only way we know for sure, is to ultrasound. So do we need to ultrasound every cat that has a murmur?

Feline Murmurs VetPrep

- What treatment options are there?
  - Cats without CHF
    - No evidence that any of the treatments for feline cardiac disease delay the onset of CHF or prolong survival if given prior to the onset of CHF
    - Occasionally administered if marked structural changes and suggestion of elevated filling pressures
    - Unknown whether BSB is cardiac disease or a “normal” variation

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

Well, really it depends to me whether we're going to treat it differently. So for example, if I have a clinically normal cat that has a heart murmur, got no signs of congestive heart failure, does not have any signs of that even close to congestive heart failure. If I ultrasound them, and I find a disease process such is most common hypertrophic cardiomyopathy, am I going to treat it for hypertrophic cardiomyopathy? Well, then we have to think about the success rate of treatment, and actually for HCM, there is no evidence that any of the treatments that we give will delay the onset of congestive heart failure, or prolong survival if they're given prior to the onset congestive heart failure. So you could argue that unless they've got congestive heart failure, we don't need to investigate them. Now that doesn't really hold, because sometimes we might be going to do something to these cases that we need investigations for. But certainly if the owner isn't keen on having investigations, or he's only going to be able to afford one lot of investigations, it's probably better to wait to the clinical signs. Occasionally, we'll give medications just prior to the onset of congestive heart failure if we have changes that are suggestive of elevated blood pressures, but typically we're not getting treatments until they're either close to congestive heart failure, or have already developed congestive heart failure. And as I say, this basilar septal bulge is probably a normal variation more than cardiac disease, or if it is a disease, that's so benign that we probably not going to treat those cases anyway.

Feline Murmurs
VetPrep

- What investigations are warranted?
  - Assess BP
  - CBC, serum biochemistry, total T4 (esp. in cats >7 years)
  - Urinalysis
  - Thoracic radiography
  - ECG
  - Echocardiography
  - Where appropriate:
    - Tnl or NTpro-BNP
    - Infectious disease testing (*Toxoplasma* serology, *Bartonella* serology, blood culture)
    - Gene testing

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

If we are going to investigate a case, what is that going to involve? How much is it going to cost? And what are they going to need to do? Well, investigations, if I hear a murmur, what age is the cat? Is it likely to be a secondary cardiomyopathy? Because I don't want to be missing those. So, for me, I'm always going to assess the blood pressure in actually, in a younger cat, I want to know if it's low, I want to know if it's high, what that blood pressure is doing. Bloodwork. If they're not in congestive heart failure, I can get blood relatively safely, I want to be able to assess the CBC, biochemistry, and especially that T4. Then you might want your analysis to see if their kidneys are working appropriately. If I do need to suddenly start treating congestive heart failure for example, down the line, I want to know what their renal function is doing. So. We can look at that. We might think about looking at fasted radiography, and assessing them, and see if they've got any signs of cardiomegaly, looking at their vasculature, and seeing if there's any suggestion that is becoming distended, particularly the business side of things and they might be going into congestive heart failure. We can look at ECG, or EKG, we could look on echo, and see what's going on. If you're in general practice, and you're concerned you want to rule out congestive heart failure, or very severe cardiac disease, we might consider testing a troponin I usually I do troponin if they have dysrhythmias. If I'm just looking at cat that's got a murmur, and usually I'm doing echo, but I want send it back to the practice if they've got a baseline of where its heart is. I'll have to assess its heart, and lungs in like an NTpro-BNP. And so the referral practitioner can run those down the line, and keep an eye for any changes. If that something shoots up, then that would be a good time to reassess that case. If they're unwell, and they're worried about endomyocarditis, and the most common cause in cats is toxoplasma, and bartonella. So we might consider running those if we're worried about bacteria causing doing blood culture. We can do gene testing in some of those breeds that have genetic mutations known that will lead to hypertrophic cardiomyopathy. So those are the investigations we're thinking about. If we do all of them, that adds up. It can become very expensive. And so, not owner-- every owner is going to want to do that.

Feline Murmurs
VetPrep

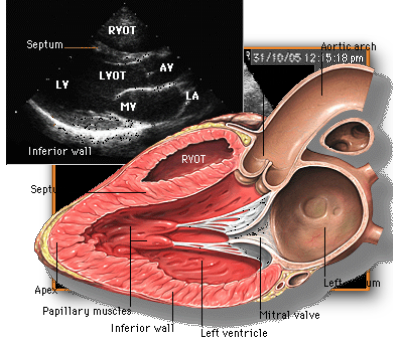
- **How do I explain this to the owner?!**
  - In cats with low-grade murmurs, the circumstances of the individual patient should be considered, and options discussed with the owner
    - Are you needing to perform any interventions/fluid administration for other diseases?
      - What about emergency procedures? Are you/they equipped for rapid assessment?
    - Does the owner "need a name" (and are they aware that the name will not give them a prognosis)??
    - Lack of treatment options
    - Insurance
    - Breeding cats
    - Stable disease now does not mean it might not need to be investigated in the future!

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

So for me, how do I explain this to the owner? Well, if a cat has a low grade murmur, it is going to depend very much on the owner's individual circumstances as to whether we're going to refer or not. And if they have a low grade murmur, no clinical signs, I'm going to base that decision on whether they're going to need any interventions, or fluid administration, or the other disease processes going on. If they don't, and they're otherwise, they are three-year-old cat that's indoor only, that isn't needing any surgeries, any fluids or anything, then I'm less likely to do investigations. But one thing to consider is what emergency-- Sorry, what emergency procedures you've got. What emergency backup you've got. If you need to do a rapid assessment, have you got the equipment to look at that cat? If it might be cardiac, but you're not sure, are you able to have a quick look at left atrial size? Or is that going to be out with your skill set? So if you have a case, just think about what could happen down the line. But if you've got very good local referral center that's nice and close, you've got a case that's stable, never had any clinical signs, it's got a low to medium grade murmur, it's very healthy, then you're probably not going to need to investigate. However, some owners need to know. They want to know what that murmur means. They want to know that the disease is X. Now, I'm not going to go into all the diseases, because we'll run over by hours, but actually giving a cat cardiac disease a name doesn't tell you the prognosis, and it doesn't alter what treatment options you have. So it's something for the owners' peace of mind, but it's probably not that useful for the cat, or for you knowing what to do with the cat. Are they insured? Some insurance plans will only cover a problem for a year. So if you notice a murmur, and they only have insurance that covers them for a year, and you want to know what the underlying disease is at that point in time, then yes, it is worth it referring them, so that you can at least have the baseline investigations done on the insurance. And some owners will want to know why they have that insurance in place, because once you've heard murmur, if they only do have a one year insurance plan, it will be excluded after that year. Are they a breeding cat? If they're breeding cat with a known genetic link to a cardiac condition, then certainly I would recommend investigations to see if it is a significant murmur or not, and make sure the owner is aware that just because it might not warrant investigations now, does not mean, it's not something that you need to keep an eye on, you're going to need to monitor it closely, and you might be recommending investigations in the future if that changes.

Feline Murmurs
VetPrep

- **The unstable patient**
  - Provide oxygen therapy
  - Perform thoracocentesis if pleural effusion present
  - If semi-stable assess LA size to confirm presence of CHF &/or snap pro-BNP (blood or PL effusion)
    - If suspected CHF or not possible to measure LA size administer 2 mg/kg furosemide i.v. (i.m. if access can't be gained).
    - Reassess at peak effect (1 h post i.v. administration)



Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

So there are probably the most complex ones to make decisions on. In our unstable patients that have signs of cardiac disease, what are we going to do? Well, first things first. We're going to give them oxygen. If they have pleural effusion, then we want to drain it. Now, we may get an idea from our physical exam from that compression, percussion. We might get an idea from being able to put in an ultrasound probe on and having a look to see if they've got pleural infusion. But perform thoracocentesis if they have pleural effusion. If they're relatively stable, and you can assess left atrial size on ultrasound, do, if not, then see if you can run a SNAP pro-BNP, look for the presence of congestive heart failure. SNAP pro-BNP can be useful to run on the pleural effusion or on blood, and it may help guide you as to whether it's cardiac in origin. If you suspect congestive heart failure, if it's high on your list, even if you're not sure, then it is worth giving 2 mg per kg of furosemide, and you can give that intravenously or intramuscular if you can't get intravenous access. That should work within an hour, so reassess at the peak effect, which is 1 hour post IV administration, and see if they have stabilized. If not, a second dose, and if they don't respond to two doses, then realistically you do want somebody else to try and assess this case, if you can't investigate that. So if you're having a quick look on ultrasound, this always scares everybody, and it's really a good idea just to try and do it on normal cases that come into the clinic. This is the left atrium, that's what we're looking at. So this is the long axis view, where we've got our probe literally at 90 degrees to the cat chest, just behind the elbow. And we will see an image of it like this with our interventricular septum, posterior wall, mitral valve, left atrium, left ventricular outflow tract and aorta. If we rotate 90 degrees, we will see what's called a heart base view, where we will have the aorta in the middle with a Mercedes-Benz type sign flashing up at us, and the left atrium, depending which way you twist, left atrium may be over to the left of the screen, or the right to the screen. So here's an image from a cat, this is our left atrium. And this is the aorta. Now, the left atrium to aortic ratio should be about one to one, certainly no more than 1.5 for the left atrium. So you can see here, this left here is around about three and half times the aorta. This is a cat in congestive heart failure, you can see also that that's what we call smoke in here, and this is red blood cells trying to form a clot. OK. So heart rate's 199, so not to be abnormal, but we have this massive left atrium, and that is actually incredibly easy to see.

This is just another case, we have our aorta here. You can see a Mercedes-Benz particular clearly, and then we've got a left atrium that is certainly over 1.5, not markedly over, but we've got a big clot bouncing around in this left atrium.

Feline Murmurs VetPrep

- **When should I refer/investigate?**
  - Full evaluation should be performed when the cat is stable, i.e. pleural effusion has been drained, and/or diuretics administered.
  - If the cat has clinical signs of heart disease
  - If it is a breeding cat with a murmur
  - If the owner wants to know the underlying causes
  - If you know you need to perform an intervention that requires prolonged GA or fluid boluses etc.

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So, for me, for heart murmurs, when should you refer or investigate? I would say investigations and referral, you want to do when they're stable. So if they've had clinical signs, drain the effusion, gave diuretics first, let them stabilize before stressing them with investigations. If the cat has clinical signs of heart disease, but isn't in congestive heart failure, it is worth investigating. If they are breeding cat with a murmur, particularly one of the breeds that's predisposed to HCM, then I would definitely investigate. If the owner really wants to know the underlying cause, there's nothing wrong with doing investigations. And if you're going to need to perform intervention, or require longer GA or fluid boluses, then I would definitely want to know is the left atrial size, and pressure profiles.

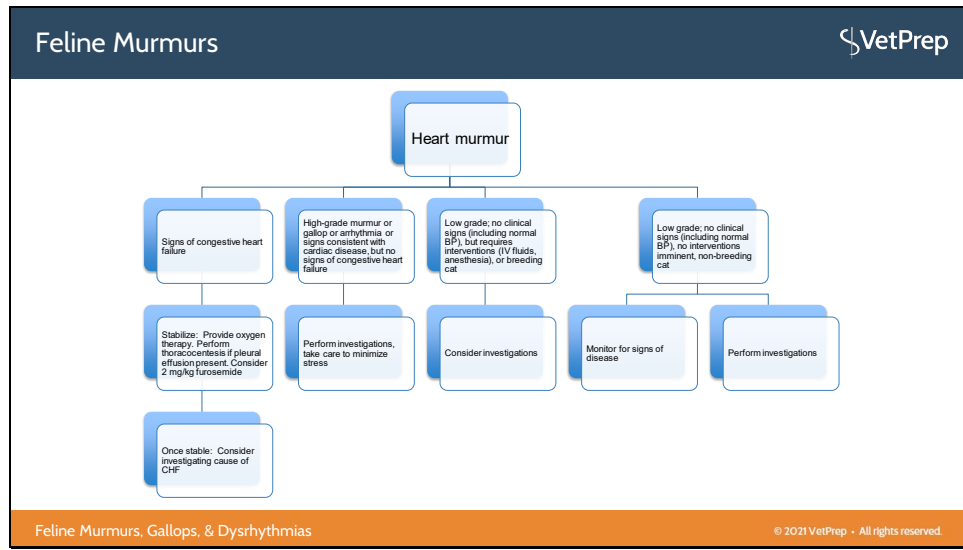
Breeds Recognized as Having an Increased Risk of HCM VetPrep

- Maine Coon\*
- Ragdoll\*
- Turkish Van
- Cornish Rex
- British Shorthair
- Sphinx
- Siberian
- Persian
- Devon Rex
- Norwegian Forest Cat
- Scottish Fold
- Bengal
- American Short-Hair

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So if we're thinking about those breeding cats with heart murmurs, this is the list. Obviously, the Maine Coon and the Ragdoll we do have gene tests for. Gene test negative does not mean they don't have HCM. There are certainly more than one mutation in those breeds that can lead to HCM. So we do see HCM in cases that are gene test negative, but there are a lot of breeds that are predisposed to HCM. So realistically, if it's a pedigree cat that's being bred from, or a cat was being bred from and it's for the murmur, I would recommend investigations.





So just putting that together for murmurs, if we have a heart murmur, first off, are there any signs of congestive heart failure? If there are, stabilize them and then once they're stable, consider investigations. If they have a heart murmur, and it's a high grade murmur, or they've got other cardiac abnormalities, such as gallop, arrhythmia, or signs consistent with cardiac disease, but no signs of congestive heart failure, then certainly investigations would be recommended, but make sure that you're doing in the low stress environment possible, especially if they haven't already started on treatment. And if they are very stressed, it can really suspicious that they have cardiac disease, it can be an idea just to give a little bit of furosemide, 1 mg per kg of furosemide before investigations just to make sure that you're not going to cause flash pulmonary edema, if they have a low grade murmur, but no clinical signs, they've got normal blood pressure, they are going to need intervention. So they're going to need an anesthetic, prolonged anesthetic, IV fluids, or a breeding cat, then I would consider investigations. That they have a low grade murmur with no clinical signs, and you're not going to be doing any intervention, they're not breeding, then you can either monitor them for signs of disease, or perform investigations. And I would leave that as a discussion between you and the owner, based on their finances, based on the availability of the nearest referral center.


OK so that's my approach to heart murmurs, and it is the most complex of the things we're going to talk about, which I've spent most time on it.

# Gallops

---



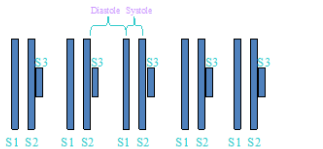
Feline Murmurs, Gallops, & Dysrhythmias

Gallops: Sounds


● **S3**

- Sound is caused by early diastolic filling
- An audible S3 implies ventricular dysfunction
- Varies with heart rate and filling pressures

Abnormal Heart Sounds

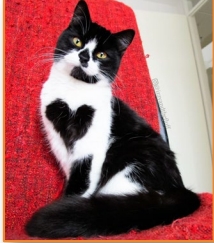


Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

Next I want to go on and talk about gallops sounds. And gallops sounds are actually quite easy, not always easy to hear, but easy to interpret. So gallop sounds are an audible S3, S4, or combined gallop, so S3 and S4 together. S3 is a sound that is caused by early diastolic filling. If you hear an audible S3, it's going to imply that you've got ventricular dysfunction, and it can vary with a heart rate and filling pressures. So with these we hear lub-dub-dub, lub-dub-dub, lub-dub-dub. And I'm going to play you an example, it is a human example, because it's a slower rate. So it's a little bit easier to get your ear into. [HEART BEAT] In cats, we're going to speed that up to about 200 beats per minute, but if it's the same it's like a horse galloping.


Gallops: Sounds VetPrep

- **Differential Diagnosis S3 Gallop**
  - Primary ventricular dysfunction
    - DCM
    - HCM
    - Myocarditis/Endomyocarditis
    - Cor pulmonale
  - Volume overload of the ventricle
    - AV valvular regurgitation
    - Anemia
    - Thyrotoxicosis
    - Volume overload
    - Left to right shunt



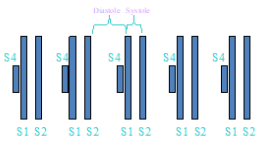
Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So what differentials do we have for an audible S3 gallop? Well, primary left ventricular dysfunction, we can hear this in dilate cardiomyopathy, hypertrophic cardiomyopathy, myocarditis, endomyocarditis or cor pulmonale. Other things that can cause audible S3 are volume overload at the ventricle. So with valvular regurgitation, with anemia, with thyrotoxicosis, with volume overload, or a left-to-right shunt. So if we hear an S3, we do need to think about all of these things. Anemia, hyperthyroidism, volume overload should be relatively easy to diagnose. The rest of the conditions are cardiac conditions. So our rule outs for non-cardiac conditions is actually pretty easy.


Gallops: Sounds


- **S4**
  - Produced by atrial systole
  - Audible if the atrium contracts against a distended or noncompliant ventricle
  - In addition, cats may present with combination gallops, in which both S3 and S4 can be heard

Abnormal Heart Sounds



The diagram illustrates four types of abnormal heart sounds: 1) A single S4 sound. 2) A combination gallop consisting of S4 followed by S3. 3) A combination gallop consisting of S3 followed by S4. 4) A single S3 sound. Each sound is represented by a vertical bar with its label (S4, S3, or S4 S3) below it. A bracket above the S4 S3 combination is labeled 'Diastole - Systole'.



Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

What about an S4? An S4 is produced by atrial systole, it is audible if the atrium is contracting against the distended, or non-compliant ventricle. So if we hear this, we're going to hear blub-dub, blub-dub, blub-dub. And it sounds like this. Again, this is a slowed down version. [HEART BEAT] If we hear a gallop, it's sometimes really hard to know if it is S4 or S3, especially when the heart rate is 200 beats per minute, and sometimes in cats, we'll even get a combination gallop. So if we know the differentials for S3 and S4, we can put them together, because oftentimes our ears aren't going to be able to differentiate which we're hearing.

Gallops: Sounds VetPrep

- **Differential Diagnosis S4 Gallop**
  - Ventricular distension/non-compliance
    - Cardiomyopathy (especially HCM)
    - Hypertension
    - Aortic/Pulmonic stenosis




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So what are differentials for an audible S4? Well, we've got a ventricle that is non-compliant, or distended, so we're likely to have cardiomyopathy, this is especially heard in hypertrophic cardiomyopathy, but you can hear it in other forms cardiomyopathy, we may have hypertension, we may have aortic or pulmonic stenosis. So in these cases, we can check the blood pressure, and the rest of our conditions are cardiac.

Gallops: Sounds VetPrep

- Referral
  - Consider the non-cardiac causes
    - Check BP
    - Is there likely volume overload?
    - Consider tT4 & serum biochemistry
    - Assess PCV
  - Gallops are more suggestive of significant disease and should be investigated
    - Echo
    - Thoracic radiographs
    - EKG



Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So if we hear a gallop sound, what we're going to do, if the cat is stable, and doesn't have any signs of congestive heart failure, we want to check if there's any suggestion of volume overload, we've just given them lots of fluid that just teetering on the bridge, if they've got some low grade crackles on their chest, you want to check that blood pressure, and see if the hypertensive. Check their blood work, particularly assessing the level of the red cell count and the PCV, typically assessing for anemia, and assessing the T4 level to see if they've got hypothyroidism. If we've ruled out the non-cardiac causes of gallop, and the chances are there are significant cardiac disease. And then yes, cardiac investigations are warranted. So we can go for echo, thoracic radiographs, EKG.

Spike

VetPrep

- Signalment
  - Seventeen month old
  - Male neutered
  - DSH



Feline Murmurs, Gallops, & Dysrhythmias

© 2021 VetPrep - All rights reserved.


And so, I just want to briefly show you this cat spike who was referred to me when he was 17 months old. He's male neutered, domestic short-haired cat.



Spike VetPrep

- IOP six weeks old
- Single cat household
- Indoor/outdoor cat
- Fully vaccinated and wormed
- Fed commercial canned diet and dried biscuits
- No exercise intolerance
- Well grown
- No dyspnoeic episodes
- No history of syncope or ataxia

- A heart murmur had been noticed 2 weeks previously
- No abnormalities auscultated at previous visits
- Not receiving any medications
- The owner did not perceive there to be any problems




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

He had been in the owner's possession since he was six weeks old. He's an indoor/outdoor cat, single cat household. He lived in a flat in Edinburgh, so although he went outside, it was very supervised. He was fully vaccinated and wormed. He was fed a commercial canned diet and dried biscuits. And basically, he was a clinically normal cat. He was well grown. He'd never had any signs consistent with congestive heart failure, and he'd been to the vet. He'd been neutered. She'd never heard a murmur. She was an incredibly good first opinion vet. Had the ears on her. She could hear heart murmurs amazingly well, and she phoned me very upset that she'd noticed a heart murmur when he came in for his annual vaccinations at 16 months old, and she'd never heard one when he was first vaccinated or when he was neutered. And so, he was referred for investigations. He wasn't on any medications, and the owner really didn't know that there was anything wrong with him.

Spike: Physical Examination
VetPrep

- BCS 4/9, Wt-4.1kg
- BAR
- MM pink and CRT <2secs
- Palpable lymph nodes: NAD
- Thoracic auscultation: regular
- HR 200bpm
- Grade IV/VI systolic murmur, PMI-left heart base. Gallop sounds audible over left heart apex

- Femoral pulse: bilaterally good, no pulse deficits
- Respiratory rate: 44bpm, no dyspnoea
- Auscultation of the lungs: no abnormalities
- Jugular: no distension
- Abdominal palpation: unremarkable
- Temperature: 38.1°C




Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

So when we saw Spike's physical exam, he was absolutely normal, body condition score, body weight was normal. He was bright. Mucous membranes were fine. There were no abnormalities in his abdomen. Lymph nodes were normal. His heart rate was 200 beats per minute, but he had come in on the bus. He had a grade four out of six systolic murmur, point of maximum intensity with the left heart base down on the cranial sternum, but he also had gallop sounds, and these were audible over the left heart apex. His femoral pulse was good. There were no pulse deficits. He didn't have any dyspnea. His respiratory rate was 44. Auscultation of the lungs, there were no abnormalities. Jugular, there was no distension. Abdominal palpation was unremarkable, and his temperature was normal.

Spike: Problem List VetPrep

- Systolic Heart Murmur
- Gallops (Audible S3/S4)




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So our problem list for Spike was that he had a heart murmur, grade 4 out of 6 systolic murmur, and a gallop sound, which we didn't differentiate whether that was S3 or S4 on our physical exam.

Spike: Differential Diagnosis VetPrep

### Systolic Heart Murmur (in young adult DSH)

- Hypertrophic Cardiomyopathy
- AV Valve Dysplasia-no murmur apparent at previous examinations
- VSD-typically right sided murmur
- ASD-usually very low grade murmur
- Restrictive Cardiomyopathy
- Unclassified Cardiomyopathy
- Dilated Cardiomyopathy
- Secondary Cardiomyopathy-unlikely at this age
- Myocarditis/endocarditis
- Physiological Murmur-not usually high grade




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So what differentials do we have for systolic heart murmur, well a pretty long list, but hypertrophic cardiomyopathy is going to be a top of the list, yes it could be congenital abnormality, it could be one of other primary heart primary cardiomyopathies. Could be a second cardiomyopathy, but he's very young. Things like hypothyroidism ,hypertension, he could have endomyocarditis or myocarditis, but there could be physiological, not usually a grade four murmur.

Spike: Differential Diagnosis VetPrep

### Gallop Rhythm

- Hypertrophic Cardiomyopathy
- AV Valve Dysplasia
- Restrictive Cardiomyopathy
- Unclassified Cardiomyopathy
- Dilated Cardiomyopathy
- Myocarditis
- Secondary Cardiomyopathies




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

Gallop rhythm, again, we've got a whole list of cardiac diseases, primary cardiomyopathies, and congenital diseases are going to be at the top of that list for Spike.

Spike: Investigations VetPrep

- Blood Pressure
- Urinalysis
- Hematology and Biochemistry
- Radiography
- Electrocardiography
- Echocardiography




Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So when he came into me, what did I do? Well, I did his blood pressure first. Got urinalysis CBC biochemistry, just did thoracic radiographs, I did an EKG, and echo.

Spike: Investigations VetPrep

- Blood Pressure (145mmHg)
- Urinalysis (Unremarkable SG: 1.048)
- Hematology and Biochemistry
- Radiography
- Electrocardiography
- Echocardiography



Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

And his blood pressure was 145, so completely within reference range, his urinalysis was unremarkable. Urine specific gravity was 10.48, maybe a little bit lower than I'd expect in a young cat.

| Spike: Bloods                      |                    | VetPrep         |        |
|------------------------------------|--------------------|-----------------|--------|
| Hematology                         | Units              | Reference range | Result |
| Red Blood Cell Count               | $\times 10^{12}/l$ | 5.5-10.0        | 9.88   |
| Packed Cell Volume                 | l/l                | 0.24-0.45       | 0.41   |
| Hemoglobin                         | g/dl               | 8.0-14.0        | 13.0   |
| Mean Cell Volume                   | fl                 | 39.0-55.0       | 42.0   |
| Mean Cell Hemoglobin Concentration | %                  | 30.0-36.0       | 31.6   |
| White Blood Cell Count             | $\times 10^9/l$    | 7.0-20.0        | 8.90   |
| Neutrophil Count (Segmented)       | $\times 10^9/l$    | 2.5-12.8        | 4.36   |
| Neutrophil Count (Band)            | $\times 10^9/l$    | 0.0-0.0         | 0.00   |
| Lymphocyte Count                   | $\times 10^9/l$    | 1.5-7.0         | 3.91   |
| Monocyte Count                     | $\times 10^9/l$    | 0.07-0.85       | 0.27   |
| Eosinophil Count                   | $\times 10^9/l$    | 0.0-1.0         | 0.36   |
| Basophil Count                     | $\times 10^9/l$    | 0.0-0.0         | 0.00   |

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

His CBC when we did that, again completely unremarkable.



| Spike: Bloods        |        |                 |        | VetPrep |
|----------------------|--------|-----------------|--------|---------|
| Biochemistry         | Units  | Reference range | Result |         |
| Alanine Transferase  | IU/l   | 6.0-83.0        | 54     |         |
| Alkaline Phosphatase | IU/l   | 10.0-100.0      | 15     |         |
| Creatinine Kinase    | IU/l   | 50-200          | 738    |         |
| Calcium              | mmol/l | 2.1-2.9         | 2.44   |         |
| Cholesterol          | mmol/l | 2.0-3.4         | 5.99   |         |
| Creatinine           | μmol/l | 40.0-177.0      | 156    |         |
| Glucose              | mmol/l | 4.0-5.0         | 4.5    |         |
| Phosphate            | mmol/l | 1.4-2.5         | 1.57   |         |
| Potassium            | mmol/l | 4.0-5.0         | 4.6    |         |
| Total Protein        | g/l    | 69.0-79.0       | 70.9   |         |
| Albumin              | g/l    | 28.0-39.0       | 35.6   |         |
| Globulin             | g/l    | 23.0-50.0       | 35.3   |         |
| Sodium               | mmol/l | 145.0-156.0     | 156    |         |
| Urea                 | mmol/l | 3.8-9.8         | 11.4   |         |
| Bile Acids           | μmol/l | 0.0-7.0         | 3.1    |         |
| Total T4             | nmol/l | 13-48           | 31.8   |         |
| FoLV                 | +/-    | -               | -ve    |         |
| FIV                  | +/-    | -               | -ve    |         |

Feline Murmurs, Gallops, & Dysrhythmias

© 2021 VetPrep - All rights reserved.

| Spike: Bloods        |        |                 |        | VetPrep |
|----------------------|--------|-----------------|--------|---------|
| Biochemistry         | Units  | Reference range | Result |         |
| Alanine Transferase  | IU/l   | 6.0-83.0        | 54     |         |
| Alkaline Phosphatase | IU/l   | 10.0-100.0      | 15     |         |
| Creatinine Kinase    | IU/l   | 50-200          | 738    |         |
| Calcium              | mmol/l | 2.1-2.9         | 2.44   |         |
| Cholesterol          | mmol/l | 2.0-3.4         | 5.99   |         |
| Creatinine           | μmol/l | 40.0-177.0      | 156    |         |
| Glucose              | mmol/l | 4.0-5.0         | 4.5    |         |
| Phosphate            | mmol/l | 1.4-2.5         | 1.57   |         |
| Potassium            | mmol/l | 4.0-5.0         | 4.6    |         |
| Total Protein        | g/l    | 69.0-79.0       | 70.9   |         |
| Albumin              | g/l    | 28.0-39.0       | 35.6   |         |
| Globulin             | g/l    | 23.0-50.0       | 35.3   |         |
| Sodium               | mmol/l | 145.0-156.0     | 156    |         |
| Urea                 | mmol/l | 3.8-9.8         | 11.4   |         |
| Bile Acids           | μmol/l | 0.0-7.0         | 3.1    |         |
| Total T4             | nmol/l | 13-48           | 31.8   |         |
| FoLV                 | +/-    | -               | -ve    |         |
| FIV                  | +/-    | -               | -ve    |         |

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

His biochemistry demonstrated an increase in his CK level, these are in UK units, because I saw him in the UK, but his CK 738 with the reference range of 50 to 200. His cholesterol was high for our lab, although our reference range was quite low. So it was sitting at 5.99 with a reference range of 2 to 3.4, and his urea was slightly elevated at 11.4. He was a FELV and FIV negative.

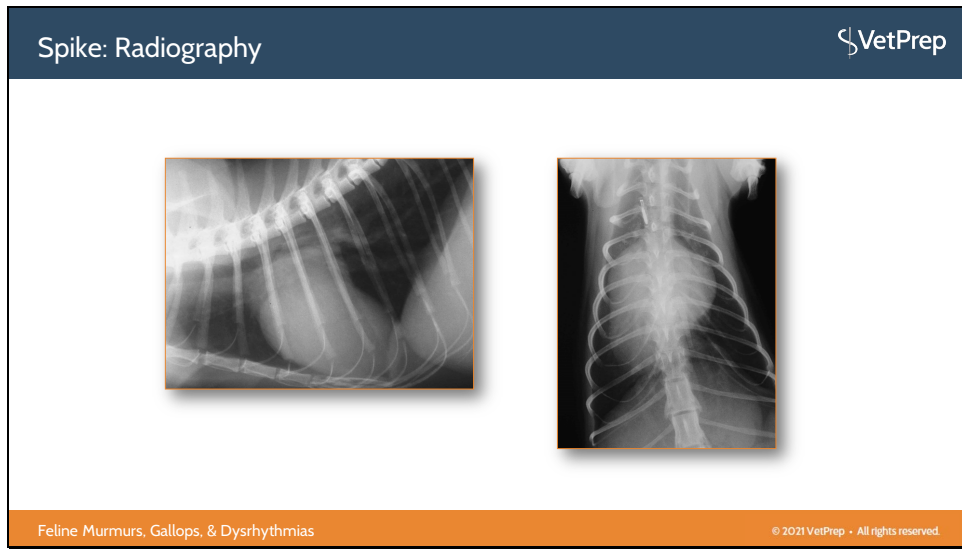
And really that mild increasing in urea, we've got lots of differentials, but increased metabolism is one of those, and the same for the increase in cholesterol.

Spike: Bloods VetPrep

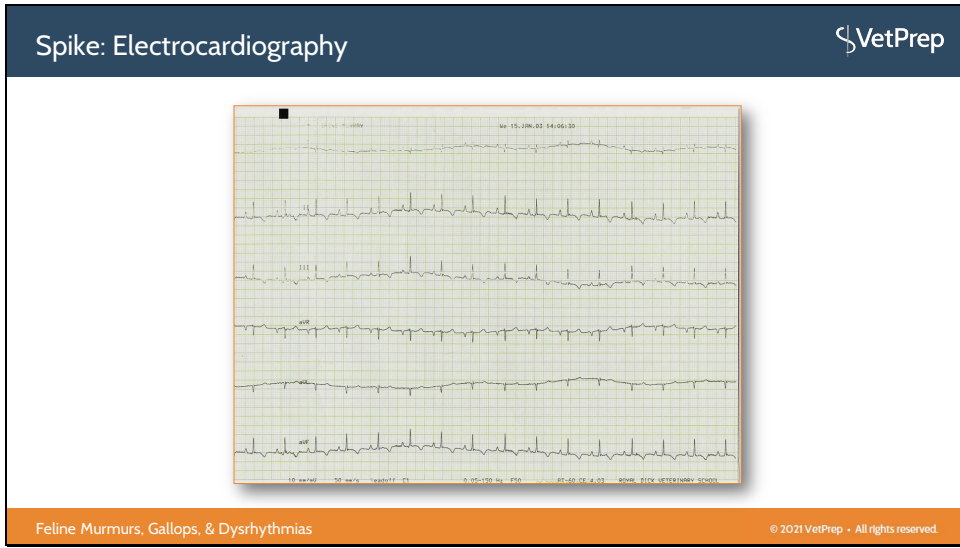
- CK may be elevated (not cardiac specific)
- Tnl
- Pro-BNP

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

The CK could be suggestive of muscle damage that might have just been banging around on the journey coming in, but CK can be elevated in cardiac disease, but it is not specific for cardiac muscle in small animals. So bloods that we could do to look more specifically at cardiac muscle would be troponin, or prob BNP. However, he was a referral center, I've got an ultrasound, and that's going to be more accurate than looking on blood work.



So first off, we took some radiographs of Spike's chest. And these are very classic radiographs, you can see on the lateral view, he's got sort of a banana shaped heart, or kidney bean shaped heart, and that's because he's got left atrial enlargement pushing that trachea up and causing that wasting on the back of the heart. On the DV view, he's got a classic valentine heart that's taking up the entire width of the chest. So again, we know he's got cardiomegaly. He doesn't have obvious venous engorgement on the radiographs, but there was just a little bit of bronchial cuffing. So a little bit more of a bronchial pattern than we would expect, which is suggestive that it's a little bit closer to forming congestive heart failure.

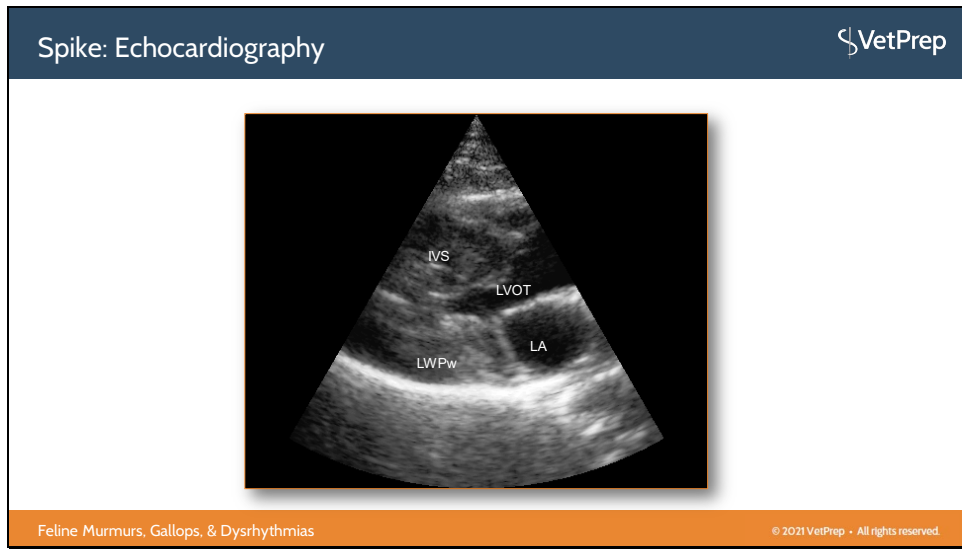


We took an ECG, or an EKG, which showed a nice normal rhythm, and there were no ectopic complexes on there, but when we measured the lead two complexes,

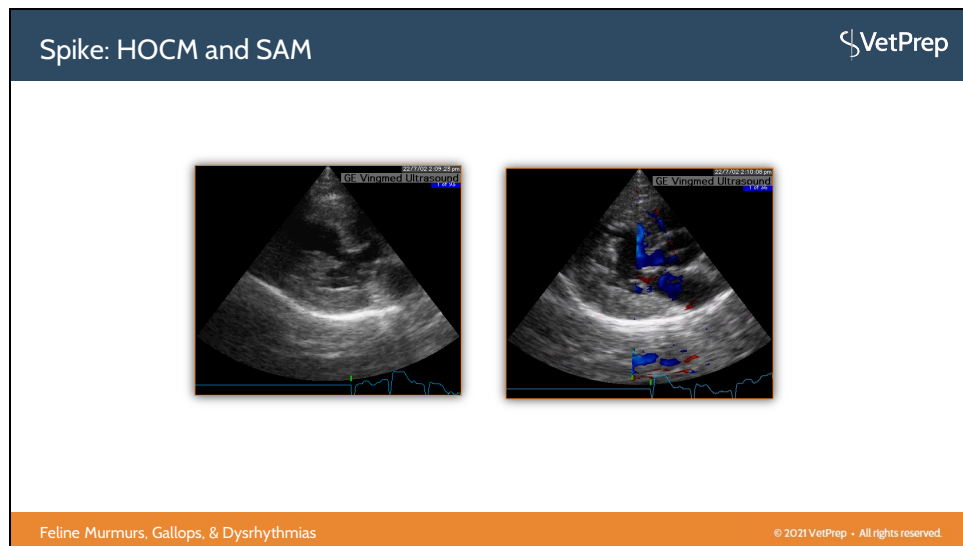
| Spike: Electrocardiography  |  |                 |        | VetPrep |
|---|--|-----------------|--------|---------|
| Parameter   | Unit                                   | Reference range | Result |         |
| Heart rate  | bpm                                    | 120-240         | 180    |         |
| Sinus rhythm  |  |                 | yes    |         |
| P wave duration   | msec                                   | <0.04           | 0.04   |         |
| P wave amplitude  | mV                                     | <0.2            | 0.3    |         |
| P-Q interval  | msec                                   | 0.05-0.09       | 0.08   |         |
| QRS duration  | msec                                   | <0.04           | 0.02   |         |
| R wave amplitude  | mV                                     | <0.9            | 0.95   |         |
| Q-T interval  | msec                                   | 0.12-0.18       | 0.18   |         |
| Mean electrical axis  | degrees                                | 0-160*          | 80*    |         |
| Comments  | No S-T segment depression or elevation |                 |        |         |
| *Tilley L.P. Essentials of Canine and Feline Electrocardiography, 3rd ed. Philadelphia, Lea and Febiger, 1992 (Tilley L.P. 1992). |  |                 |        |         |

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

We did have a slightly long p-wave duration, slightly tall p-wave amplitude, and a slightly tall r-wave amplitude. And although this is very inaccurate looking at left atrial enlargement, this suggests that the left side of enlargement, This would suggest that he has got some left sided enlargement because we forgot to wave. The P waves in cats actually don't differentiate very well between left and right side. So just really tells us that would be a bit concerned that he's got some atrial enlargement on that.

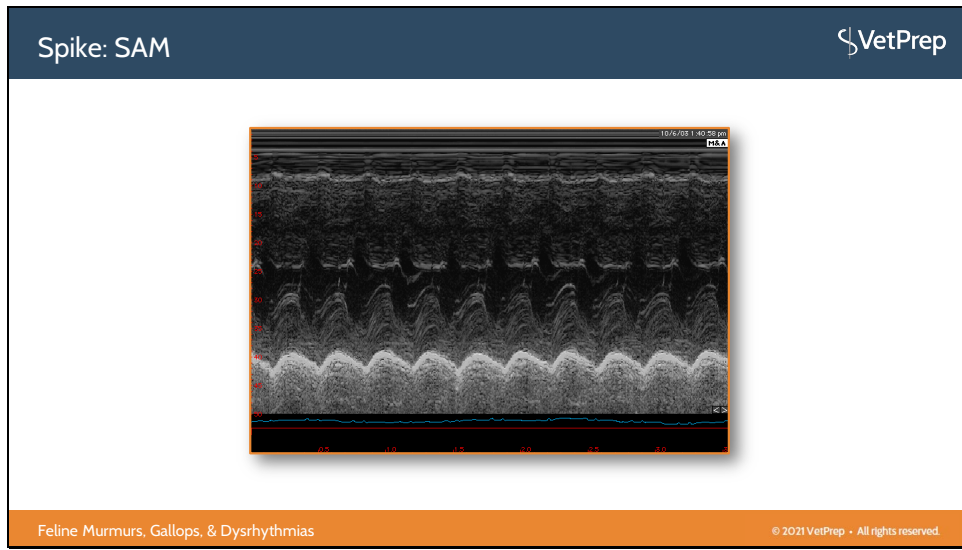


And so, we're going to look on echo with him. And this is Spike's heart, so we can see just on the still imagery that is frozen, and this during systole, we have a very thick ventral vascular wall, and certainly at least at heart base, we've got thickening at the endometrium of the septum. So you've got papillary muscle and chordae tendineae coming in just behind this.



And if we look at his heart beating, you can actually see there's a large area of hypertrophy at the top of the intraventricular septum, and when we put color on there, we've got a lot of turbulence as the blood's trying to go past that area of hypertrophy. But when we measured his heart muscle, it was generally thickened, so we know that he's got generalized hypertrophy, but we've left ventricle outflow tract turbulence, and that leak in the mitral valve that we talked about earlier. So that's systolic control emotion, and hypertrophic obstructive cardiomyopathy.





And we can see that on his M-mode, if we take an M-mode at the level of the mitral valve, we can see the mitral valve leaflets opening up against the intraventricular septum and then they should be closed, and that's where we're getting that leakage through the mitral valve.

Spike: Diagnosis VetPrep

- HOCM
- Prognosis
  - ? Better than HCM
  - Young with LA dilation
  - Alive and well 24 months post diagnosis

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So Spike was diagnosed with hypertrophic obstructive cardiomyopathy. He's got a gallop, which is why it's very important that we investigated him, and he does have significant cardiac disease. He's got-- he had a slightly enlarged left atrium, and so we judged him as being on the edge of going into congestive heart failure, and we did actually start him on medication. He responded incredibly well, he was followed up for the next two years, and he was alive and well 24 months after diagnosis, when unfortunately the couple that owned him split up, and he was rehomed to the parents of the gentleman who owned him, and then we lost follow up on Spike. But just to point out really that gallops sound is the big trigger to say this is significant cardiac disease, and this is why Spike has been investigated

# Dysrhythmias

---




Feline Murmurs, Gallops, & Dysrhythmias

Finally, and very briefly, I just want to touch on dysrhythmias, what they mean when we see them in general practice.

## Sinus Arrhythmia

VetPrep

- **Increased Vagal Tone**
  - Respiratory obstruction
    - Nasal stenosis
    - Laryngeal or tracheal narrowing
  - Mediastinal
  - Abdominal Disease
    - Gastric
    - Pancreatic
    - Peritoneal
  - Not cardiac disease



Feline Murmurs, Gallops, & Dysrhythmias

© 2021 VetPrep - All rights reserved.

Probably one of the most commonly talked about dysrhythmias we see is sinus arrhythmias. And if we see sinus arrhythmia, it means that there's increased vagal tone. This is not normal in a cat in a clinic, they usually have a nice sympathetic response, and you're not going to hear sinus arrhythmia in a clinic. You can hear it on your cat at home, if you listen to cat in the home environment, you may hear it. So if we hear it, may represent increased vagal tone, because we've got respiratory obstruction, and that can be nasal stenosis in cats with no nose, or it may be that we've got tracheal or laryngeal narrow. Well, we can also get increased vagal tone if we've got mediastinal disease, or if we've got abdominal disease, typically cranial abdominal disease, so things like gastric pathology, pancreatic pathology, or peritoneal pathology. Very occasionally, I even hear it after cystocentesis on a distended inflamed bladder. However if the heart is responding to alterations in vagal tone, it is actually a pretty healthy heart. So if you're hearing a sinus arrhythmia, it's suggestive that it's not cardiac in origin, and you need to go looking for another medical cause. Often when cats have sinus arrhythmia, they have a relatively low heart rate as well.

Dysrhythmia VetPrep

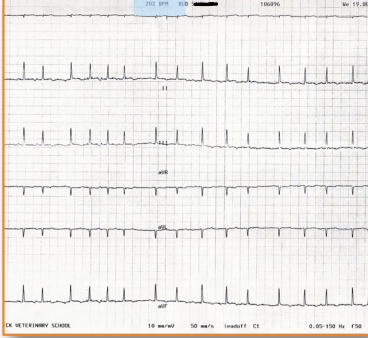
- 5 Basic Groups
  - 1) Primary electrical disturbances of the heart: due to macroscopic or microscopic structural cardiac disease or related to channelopathies
  - 2) Metabolic and endocrine diseases often are associated with arrhythmias: these may be reversible!
  - 3) The autonomic nervous system can initiate or aggravate arrhythmias
  - 4) Drugs and toxins can affect the electrical activity of the heart
  - 5) Specific disorders i.e. Trauma

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So what about the actual dysrhythmias, the abnormal rhythms? Well, these fall into five basic groups, and we're already over time. I'm not going to run through all of the five basic groups. But we can have primary electrical disturbances in the heart, which are due to the macroscopic, or microscopic structural cardiac disease, or channelopathies. And therefore, can cause significant issues. We can also get metabolic and endocrine diseases that are associated with dysrhythmias, and these can be reversible. So we really want to look carefully at this. The autonomic nervous system can initiate, or aggravate arrhythmias. And so, if we have an arrhythmia that's caused by an endocrine disease, and the most common endocrine disease, the most common cause of dysrhythmias that I see in cats is hyperthyroidism. These cats frequently have dysrhythmic hearts, and they've got increases in their autonomic nervous system, and an endocrine abnormality that's predisposing them to the dysrhythmias. And if you treat that dysrhythmias, those-- Sorry, if you treat the hyperthyroidism, those dysrhythmias will often go away. Drugs and toxins can affect the electrical activity of the heart, which is why we see so many dysrhythmias in anesthetized cats, for example, and specific disorders such as trauma, if you listen to a cat that's just been hit by a car, 75% of them actually have a dysrhythmias at least in the short term, most those resolve quite quickly. So which dysrhythmias do we need to be very cautious of and on the lookout for?

Dysrhythmia
VetPrep

- **Atrial Fibrillation**
  - Of course cats are tricky!!
    - Heart rate isn't 'abnormal'
    - Pulse quality is poor
    - Irregularly irregular (but can be subtle)
  - Causes
    - Atrial distension
    - Needs cardiac investigations




The ECG tracing displays four leads (I, II, III, aVF) showing a rapid, irregularly irregular rhythm. There are no discernible P waves before the QRS complexes, which is characteristic of atrial fibrillation. The heart rate is approximately 200 bpm.

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

Well atrial fibrillation is definitely one. And cats like to be difficult. We always think of atrial fibrillation as causing a fast heart rate, and we need to try and slow down that heart rate. Well, that's not true of cats. Oftentimes with atrial fibrillation, the heart rate is not abnormal. What we find is it's irregularly irregular, that can be really subtle, and the pulse quality can be poor. So if you look at the ECG the screen, it looks relatively normal. You've got these small complexes, but if you just start looking at how regular those beats are, it is irregular, and it is irregularly irregular. But it's hard when you're listening, because look the heart rate is normal, it's 200 beats per minute. So you've got to be really paying attention to is this rhythm exactly where it should be? If you do notice a dysrhythmia that is a irregularly irregular, and you got an EKG, have a close look are that P waves, there are no P waves on this ECG. So, if that's the case, then you've got a diagnosis of atrial fibrillation, that is most likely to be caused by atrial distension, and therefore, you need to do cardiac investigations, but prior to doing those kind of investigations, I would give some furosemide to decrease the size of that left atrium.

Dysrhythmia
VetPrep

- **Ectopic Complexes**
  - Ventricular ectopics
    - **Non-cardiac causes**
      - GI disease
      - Hypoxia
      - Chest/Abdo trauma
      - Splenic disease/GDV
      - Systemic inflammation
      - Hypokalemia
      - Hypomagnesemia
      - Toxins
    - **Structural heart disease**



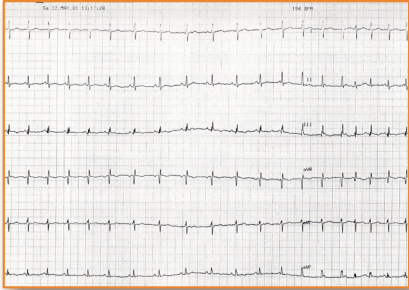
The image shows a 12-lead ECG tracing on a standard grid. Several premature, wide, and bizarre QRS complexes are visible, which are characteristic of ventricular ectopic complexes. These complexes occur at irregular intervals and are not preceded by a P wave.

Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

Other things we can say are ectopic complexes, and the most common ectopic complexes we're going to see are ventricular ectopic complexes. And these can occur for a variety of reasons, and they're not just structural heart disease. So do you think about the non-cardiac causes. It can be hypoxia, this is the most common dysrhythmias we hear after trauma, it can be the splenic disease, GDV, which is rare in a cat. We can get it with systemic inflammation, electrolyte abnormalities, toxins, GI disease. So that the EKG you're looking at, is actually from a cat with severe pneumonia and cyanosis that came in, and very confusingly, he also had a grade three heart murmur, so he had a heart murmur and dysrhythmias, we did cardiac investigations to make sure there were no underlying cardiac abnormalities there. The big clue that it was respiratory in origin was that he was coughing and cyanotic. And this dysrhythmia resolved once we treated his underlying pneumonia.

Dysrhythmia
VetPrep

- **AV Block**
  - Not uncommon in cats
  - Often asymptomatic
  - 2<sup>nd</sup> and 3<sup>rd</sup> degree AV block
  - Ventricular Escape Rate is typically approx. 100bpm or more



Feline Murmurs, Gallops, & Dysrhythmias
© 2021 VetPrep - All rights reserved.

The one that is incredibly hard to pick up, and you will often find is an incidental finding when you anesthetize a cat, is AV block. These are not uncommon in cats, and even unaesthetized cats, but it's just very hard to detect. So they're often incidental finding on your ECG, they are very often asymptomatic, and in many cases, we don't treat them, we often monitor them. Second and third AV block are most common. And I would personally find the rhythm circuits in the ECG incredibly frequently. So this is AV dissociation, which is a form of third degree AV block. If you look at the interval between the P wave and QRS, you'll see that it varies. So in the very first complete complex, you can see it's very close, and it almost goes into the QRS, and then you see that P wave coming away from the QRS as the heart rate slows down a little bit, and the P wave is walking further and further away, and then when we get about 3/4 of the way along the page, you can see that P waves start to go back into the QRS complex, and it goes right the way through. So where the lead numbers are just after lead 2, the first lead after that, you can see that P wave is actually after the QRS. And that's because atrial electrical activity is completely dissociated from that ventricular electrical activity. So what we're seeing here, are actually ventricular escapes, but because the ventricular escape beat is often fast in cats, it's not even a bradycardic rhythm. This cat's heart rate is 194 beats per minute. So you're not going to pick this up, unless you notice this subtle dysrhythmias, and realistically, yes, it's going slightly slow in the middle of the ECG. It's only towards the end of the ECG that you've got that ectopic beat, or that fusion beat that comes in, that is three beats from the end of the ECG that you're likely to start to hear a dysrhythmia. So these can be very challenging to pick up.



Dysrhythmia VetPrep

● **My Approach!**

- Assess EKG to decide what the disturbance is
  - **Atrial Fibrillation-Administer furosemide and refer/investigate**
  - **Symptomatic Patient:**
    - Check blood pressure
    - Assess tT4, electrolytes, biochemistry, CBC, acid-base (ideally)
    - Consider non-cardiac causes if possible rule in/out; withdraw any medications
    - Consider referral/investigation
  - **Asymptomatic Patient**

Feline Murmurs, Gallops, & Dysrhythmias © 2021 VetPrep - All rights reserved.

So my approach to a dysrhythmia in cats, is to try and assess an EKG, and work out what's wrong. If you're not sure, send it to a referral practice though, they'll usually interpret it for you. If it is atrial fibrillation, you want to give furosemide and refer or investigate. If it's an asymptomatic patient, then that is a very long discussion with the owner, again, thinking about all the same things we're thinking about with murmurs. If they are symptomatic, then but stable, check the blood pressure, assess for diseases that can cause dysrhythmias such as hyperthyroidism, which could cause a wide range of dysrhythmias, check the electrolytes, check biochemistry, CBC, and if you can do an acid-base do an acid-base, and consider the non-cardiac causes of dysrhythmias, and if you can find them, and treat them, treat them. If they're on any medications, or it's a potential toxin exposure, just try and treat that or withdraw any medications. If you can't find a non-cardiac cause, then yes, I would consider a referral or cardiac investigations of those patients.

Thank You!

---



Feline Murmurs, Gallops, & Dysrhythmias

OK, so I hope that is a very fast walk through of the murmurs, gallops, and dysrhythmias in cats. I hope that's helpful for everyday practice, and you've enjoyed the session. And thank you to Vet Prep for asking me to do this.

## References:

1. Nakamura RK, Rishniw M, King MK and Sammarco CD (2011) Prevalence of echocardiographic evidence of cardiac disease in apparently healthy cats with murmurs. *Journal of Feline Medicine and Surgery* 13, 266--271
2. Wagner T, Luis Fuentes V, Payne JR, McDermott N and Brodbelt D (2010) Comparison of auscultatory and echocardiographic findings in healthy adult cats. *Journal of Veterinary Cardiology* 12, 171-182

## Image Credits:

*All images and videos provided by Kerry Rolph, BVM&S, CertVC, PhD, FANZCVS (Feline Chapter), DipECVIM-Ca, FRCVS.*