Critical Care Management of the Avian Patient (Part One)

Sarah Harris, CVT, VTS (ECC)

DoveLewis Annual Conference Speaker Notes

Introduction:

Most exotic pets are prey species that tend to hide signs of illness until disease is well advanced. Much of this stems from the instinct to avoid predation, by outwardly appearing healthy. It should be considered that any exotic patient that presents on emergency likely has significant underlying disease. The one exception to this would be cases presenting with acute trauma.

Assessment:

Assessment of the exotic companion animal starts with history collection. It could be argued that an accurate history can be equally or even more important than the physical exam. In exotic species, history taking is crucial because many disease processes are directly connected to inappropriate diet or improper husbandry. Reproductive emergencies also represent a moderate percentage of exotic emergencies. It is important to understand that owners may be calling their pet a male or a female, but the gender they state may not be accurate. Unless the species is dimorphic, DNA testing or specialized probing may be required to reveal the pets' gender. When exotic species present in an emergency, rapid assessment and appropriate supportive care are essential to good outcomes. Over-handling of species that are prone to stress can lead to significant consequences, therefore preparedness is important. Prior to examination, all materials needed for the exam and for diagnostics should be organized and readily available. It is additionally important to consider the space in which the exam will take place. A small room with dimmed lighting, covered windows and locked doors is ideal, to prevent further trauma or escape. Physical examination is should be performed systematically and efficiently, with as much of the exam as possible done through visual inspection while the animal is still caged. While the approach to a physical exam is not much changed, after that similarities to dogs and cats are harder to find. Besides the obvious anatomical differences, each species comes with unique dietary, environmental needs, as well as their own common diseases. Many different species may carry common zoonotic infections and for protection of both the pet and the staff, medical gloves should be worn at all times.

Avian stabilization procedures:

Hemorrhage control: Basic interventions that can be used initially to control hemorrhage include compression with a pressure wrap. It is important to note that you should avoid

placing too much pressure on the keel or generally over the coelomic cavity. Broken blood feathers should be pulled and pressure applied to the follicle. Silver nitrate or cautery can be used on patients presenting with bleeding nails.

Subcutaneous (SQ) fluids: While SQ fluids are not appropriate for the extremely critical patient, they can be used in patients with minor blood loss or patients who are stale but mildly dehydrated. There are several spaces that could be used for the administration of SQ fluids, but the preferred location is the inguinal region. The inguinal region on either side allows for the largest volume and comes with the lowest risk of inadvertently penetrating an air sac or lung. Axillary and dorsal regions can be used but both locations come with an increased risk of iatrogenic injury and provide small space for placement of fluid.

Oral fluids (crop tubing): Oral rehydration can be completed by administering several different commercially available products or lactated ringer's via a gavage (crop) needle. While relatively easy to administer, precaution must be used for overfilling. Regurgitation of fluid back into the pharynx is an indication of overfilling and overfilling can quickly lead to aspiration. For all birds, food and fluids should be warmed before administration.

Phlebotomy: A surprisingly large amount of blood can be collected via phlebotomy in a variety of locations. Similar to mammals, blood volume is calculated as 10% of the birds total body weight. Traditionally, it is thought that 1% of the total body weight can be the volume of blood you collect from a healthy bird. In sick patients or patients that you suspect could be hypovolemic, elderly or otherwise compromised, a smaller sample should be considered. Newer literature suggests that birds can tolerate closer to 2-3% of their bodyweight. However, even small amounts of blood can provide valuable information on their clinical condition. Blood samples used for both hematology and biochemistry should be placed in heparin tubes as EDTA appears to lyse cells in several species. Common phlebotomy sites include the jugular vein (right considered larger than the left), basilic (ulnar/wing) vein, or medial metatarsal (tibial) vein.

Intravenous (IV) Catheterization: IV catheters can be challenging to maintain in the avian patient due to their thin skin. Locations are the same as the phlebotomy sites listed above. To place an IV catheter, the technician would pluck the feathers and scrub the point of insertion. Catheter size is usually limited to 24-26g over-the-needle catheters, except in very large species. The catheter can be secured with tape suture and then secured with a figure eight bandage if the basilic vein is used or a neck wrap for a jugular catheter. Unless the bird is extremely debilitated an e-collar must be placed.

Intraosseous (IO) Catheterization: IO catheters should be considered for any critical avian patient that will remain in hospital for an extended period of time. Pneumatic bones must be avoided. The locations that are safe for IO catheter placement in birds are the distal ulna or the tibiotarsal crest. The most common consequence of IO catheter placement is osteomyelitis, therefore, sterile preparation and technique must be adhered to. The site should be plucked and scrubbed and a local block of 2%lidocaine diluted with saline can be used to help facilitate placement. Size of catheter is dependent on species with 22-20g used on medium to large birds and 25-gauge needles for smaller birds. While hypodermic needles can be used, a stylet can prevent obstruction on the lumen with cortical bone.

Air Sac Cannulization: Any bird that presents with a suspect upper airway obstruction may be a candidate for an air sac cannula. These cannula's can be placed in either the caudal thoracic or the abdominal air sacs. A modified endotracheal tube or a red rubber catheter can be cut to an appropriate length. The diameter of the tube is selected of the approximate tracheal lumen size. Patency can be confirmed by placing a small feather over the opening and ventilating the patient. Air movement should be adequate to move the feather or the tube position should be adjusted. The tube can be sutured directly to the body wall using a finger trap technique.

Nursing support for the avian species:

Oxygen support: Any bird that is stressed or showing signs of respiratory distress should be given oxygen support. While there are many methods to deliver oxygen, an oxygen cage is considered the best option. Dyspneic birds are going to be less tolerant of handling and will likely become more stressed with attempts to deliver oxygen via facemask. Some oxygen cages allow you to make adjustments to fiO2% as well as percent humidity. An ideal environment for a bird presenting in respiratory distress would be 35%-50% fiO2 and approximately 70% humidity.

Heat Support: Core temperatures in avian species are generally considered inaccurate and can have significant fluctuations throughout the day. Any avian that has advanced disease that requires critical care management can benefit from an environment that includes heat support. Frequently oxygen units or cages commercially manufactured for avian patients often allow you to set the temperature to meet the patient's needs. Temperature requirements for the avian species are generally much higher than mammal species and if possible, cages should be kept between 85-90°F.

Fluid Therapy: Crystalloids are the preferred treatment for dehydration in the avian species. Maintenance dose of fluids can range from 50-150mL/kg/day depending on the species. Hydration can be assessed by evaluation of the mucous membrane color of the cloacal mucosa, although pigmentation should be considered. Perfusion status can be evaluated by the refill time of the basilica vein.

Medication Administration: Medications can be determined depending on the presenting complaint and disease state of the patient. However, pharmaceuticals including analgesics, anxiolytics, antibiotics and antinflammitory medications are frequently used in avian medicine. Doses vary significantly from mammal species and each practice could benefit from an exotic animal formulary.

Nutritional Support: Hyporexic or inappetant avian patients should be provided nutritional support while in hospital. Ingluvial (crop) gavage is indicated to assist in daily caloric intake. All avian species have a large surface area to bodyweight ration and a high metabolic rate. A sick bird can enter a catabolic state even if eating a moderate amount of food. Unless a patient is vomiting, regurgitating or collapsed, assisted feeding should be considered. If gavage feeding is not an option, an esophageal feeding tube should be considered.

Cage setup and behavioral support: When considering housing for a hospitalized avian species, the cage should allow easy access, heating and allow the patient to stand upright on a perch without their head touching the top of the cage or their tail touching the flooring of the cage. Many parrots will chew the wire on the cages so it is important that zinc and rusty metals not be used. Paper lining the bottom of the cage is more desirable then towels for adult birds. Many adult birds will tear the towels and risk ingesting fibers that could cause an obstruction. Towels can be used to create a U or doughnut shape for neonates or collapsed birds. Hot water bottles should not be left in the cage of active parrots which may chew and ingest the plastic or rubber. Toys are acceptable and may be comforting for avian patients but must be made of non-metallic, non-toxic materials that can be cleaned easily and do not pose a risk for gastrointestinal obstruction.

Common Presenting Illnesses/Clinical Signs:

Acute respiratory distress	Diarrhea
Air sac rupture	Egg Binding/Exhaustion
Burns to skin	Fractures (wings/limbs/toes)
Cloacal prolapse	Hemorrhage (blood feathers/laceration)
Collapse/Shock	Hypothermia
Crop burns/crop fistulas	Poisoning (inhalation/heavy metals)
Crop stasis (sour crop)	Trauma
Contamination of feathers (oil)	Vomiting/Regurgitation
Convulsions/Seizures	
Dehydration	

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Critical Care Management of the Exotic Patient: Exotic Small Mammals (Part Two)

Sarah Harris, CVT, VTS (ECC)

DoveLewis Annual Conference Speaker Notes

Introduction:

Most exotic pets are prey species that tend to hide signs of illness until disease is well advanced. Much of this stems from the instinct to avoid predation, by outwardly appearing healthy. It should be considered that any exotic patient that presents on emergency likely has significant underlying disease. The one exception to this would be cases presenting with acute trauma.

Assessment:

As mentioned in part one of this lecture series, assessment of the exotic companion animal starts with history collection. It could be argued that an accurate history can be equally or even more important than the physical exam. In exotic species, history taking is crucial because many disease processes are directly connected to inappropriate diet or improper husbandry. When exotic species present in an emergency rapid assessment and appropriate supportive care are essential to good outcomes. Over-handling of species that are prone to stress can lead to significant consequences, therefore preparedness is important. Prior to examination, all materials needed for the exam and for diagnostics should be organized and readily available. It is additionally important to consider the space in which the exam will take place. A small room with dimmed lighting, covered windows and locked doors is ideal, to prevent further trauma or escape. Physical examination is should be performed systematically and efficiently, with as much of the exam as possible done through visual inspection while the animal is still caged. While the approach to a physical exam is not much changed, after that similarities to dogs and cats are harder to find. Besides the obvious anatomical differences, each species comes with unique dietary, environmental needs, as well as their own common diseases. Many different species may carry common zoonotic infections and for protection of both the pet and the staff, medical gloves should be worn at all times. It should be considered that the patient's condition may be worse than expected based on initial evaluation. Many of the small exotic mammals are prey species and naturally hide signs of illness or the extent of injuries as an adapted survival technique.

Stabilization:

Many of the principles of stabilizing the small exotic mammal patients are similar to those in traditional companion animals. Modifications can be made for patient size and individual physical characteristics. Stabilization techniques that will be discussed in this lecture will include phlebotomy, intravenous (IV) and intraosseous (IO) access, intubation, and the use of sedation. In many cases, the most important initial interventions will be limited to oxygen administration and patient warming.

Intravenous Catheterization: In any patient presenting in shock, direct vascular access is always preferred. However, many exotic small mammal species will not initially tolerate this. Initial subcutaneous fluid boluses may be beneficial. In some exotic small mammals, IV catheterization is relatively easy to accomplish. Technique is similar to traditional companion species and catheter sizes of 22-26g can be used depending on the species.

Small exotic mammal IV catheterization:
Ferrets: Cephalic, jugular, or lateral saphenous veins
Rabbits: Cephalic, Lateral saphenous, or aural veins
Guinea pigs: Cephalic and lateral saphenous veins

Intraosseous Catheterization: In species smaller than guinea pigs, IV catheterization can be difficult but vascular access is feasible with intraosseous catheterization. Typically this can be accomplished using the femur (proximal through trochanteric fossa), humerus (proximal, through greater tubercle), or tibia (proximal, through tibial crest) after a sterile prep has been completed. The use of standard hypodermic needles sized 27-22 gauge is adequate. Once placed, the IO catheter can be secured with tape or suture and fitted with a t-port or an adaptor plug. Proper placement can be definitively confirmed by radiographs, although can be assumed by stability and failure to visualize or palpate subcutaneous fluid accumulation when flushing. Hypodermic needle IO catheters can occlude with bone core or blood clots. This can be resolved using a sterilized stylet or wire as a stylet, or by removing and replacing the catheter with a new needle using the same entry location. Sedation and local analgesia can both benefit the patient and facilitate placement. Lidocaine at 2mg/kg can be administered into the skin, subcutaneous tissue and periosteum.

Venipuncture: Diagnostic testing is often prolonged in the very sick exotic patient. Initial diagnostics often just include a PCV and glucose. Because a very small amount of blood is required the veterinary technician can collect from any peripheral vessel that is visible. Often the best approach is using a small needle without syringe and collecting the blood through the hub of the needle with a hematocrit tube. When larger volumes of blood are required for diagnostics, peripheral vessels might not be adequate in smaller patients.

Small exotic mammal venipuncture:
Ferret: Jugular, lateral saphenous, ventral tail artery and cranial vena cava
Rabbits: Cephalic, lateral saphenous, jugular and the auricular artery or vein
Guinea Pigs: Cephalic, lateral saphenous, femoral and jugular veins

Intubation: Intubation in fairly straight-forward in exotic carnivores, but becomes much more challenging with rabbits, rodents and other exotic species.

Small exotic mammal intubation:
Ferret intubation: Similar to cats. Use 2.5mm endotracheal tube with a stylet

Rabbit intubation: Blind intubation relies on the detection of breath sounds or visualization of condensation. This can be even more challenging in the case of arrest. Endoscope or laryngoscope guidance can be used but usually requires significant practice. Consider forced mask ventilation in emergency situations.

Forced mask ventilation: A tight-fitting mask is placed over the nares and oral cavity. An anesthetic machine or Ambu bag can be used for ventilation. This will lead to air distention in the stomach, which can be managed once ventilation is no longer required.

Sedation: In exotic mammal species anxiety can contribute significantly to dyspnea. Because of this many of these patients can benefit from the administration of low doses of sedation. Frequently, the medications that are the safest while providing the desired effect are midazolam (0.3mg-1mg/kg) +/- butorphanol (0.1-0.2mg/kg). Both can be given intramuscularly and provide relief including the reduction on anxiety as well as, decreased respiratory efforts. Once sedated, intermittent monitoring should be performed to monitor the patient's response.

Nursing Requirements for the exotic small mammal:

Oxygen Support: As previously stated, anxiety can contribute to a dyspneic presentation in any exotic species making it hard to distinguish other causes of respiratory distress. Any exotic patient showing signs of respiratory distress should receive oxygen stabilization. Many exotic small mammals may become more stressed with attempts to administer oxygen with the use of a facemask. Because of this, an oxygen cage is often considered the best option. Oxygen administration may be most effective administered to an undisturbed, resting patient.

Heat Support: Normal core temperatures can vary significantly between species of exotic mammals and in many cases are a few degrees higher than common companion mammal species. Most exotic mammals that have advanced disease can benefit from an environment that includes heat support. Care must be taken that they can get away from active warming to avoid iatrogenic thermal injury.

Pain Management: As a survival technique, exotic mammals are skilled at hiding signs of pain. Signs of pain can be subtle and these patients may continue normal behaviors such as grooming, eating and ambulating even in the presence of significant pain or trauma. Therefore, analgesics should be considered in many of these patients, even if the signs of pain are not clinically present. Both opioids and NSAIDs are commonly used in exotic companion mammals. Because pharmaceuticals should frequently be considered, an exotic animal formulary should be a main stay in any hospitals treating exotic patients.

Nutritional Requirements: Exotic small mammals range from carnivores to herbivores. Many have very sensitive GI tracts and diet should always be considered an essential part of nursing care. Many exotic small animals should be feed frequently to meet their metabolic needs as well as avoid secondary complications such as GI stasis/ileus. Several critical care feeding formulas are available for exotic species that meet the specific needs of both the carnivore and herbivore patients (or a blend for omnivores) (www.oxbowvetconnect.com). Fine grind formula is recommended for patients that will require bolus feedings through an oral feeding syringe. And there is a specific line of products from Lafeber Company designed for assisted feedings (https://emeraid.com/)

Common Presenting Illnesses/Clinical Signs:

Acute Respiratory Distress	Fractures
Anorexia	GI Stasis/Illeus
Bite Wounds	Hypoglycemia
Blunt Trauma (Falls/HBC)	Hypothermia
Dehydration	Seizures
Degloving Injuries	Shock/Collapse
Dental Overgrowth	Spinal Cord Injury/Fracture
Dental Trauma	Tumors
Diarrhea (Wet tail)	Upper Respiratory Signs
Dystocia	Vestibular Disease/ Inner Ear Dz.
Foreign Body Obstruction	Vomiting/Regurgitation

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Critical Care Management of the Exotic Patient: Reference Table

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Normal Values Exotic Small Mammals

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Species	Heart Rate (per minute)	Respiratory Rate (per minute)	Body Temperature (Fahrenheit)	Average Weight (grams)	Gestation (days)	Litter Size	Lifespan (years)
Chinchilla	160	40-80	98.6-100.4	400-600	109-120	1-4	10-20
Ferret	180-400	33-40	100-104	600-2000	42-44	4-10	5-12
Gerbil	360	90	98.6-101.3	55-100	25-30	3-7	3-4
Guinea Pig	230-380	42-104	99-103.1	700-1200	59-72	2-5	4-5
Hamster	250-500	35-135	98.6-100.4	85-150	15-18	5-10	1-3
Hedgehog	180-300	25-50	96.8-98.6	270-700	34-37	1-9	10
Mouse	300-800	60-220	97.7-100.4	20-40	19-21	4-12	1-3
Rabbit	130-325	30-60	101.3-104	1000-6000	29-35	4-10	5-12
Rat	250-450	70-115	96.6-99.5	250-520	21-23	6-14	2.5-3.5
Sugarglider	200-300	16-40	89.6-97.3	80-160	15-17	2	9-12

Cardiac Conduction and ECG Interpretation:

Back to the Basics for Veterinary Technicians

Jessica Waters-Miller, CVT

DoveLewis Annual Conference Speaker Notes

Introduction:
Understanding the anatomy and physiology of the cardiac system is the basis for understanding normal ECG's; you must understand and recognize normal before you can recognize the abnormal. The heart is composed of two sides (left and right), four chambers and four valves. Each side consists of an atria and a ventricle separated by a valve. The atria are positioned at the base of the heart and the ventricles are positioned at the apex. The right side of the heart moves deoxygenated blood, while the left pushes oxygenated blood out to the body.

The electrical conduction system:
The normal contractions of the atria and ventricles are driven by electrical impulses that start at a group of specialized cells called the Sinoatrial Node (SA). The SA node, located at the top of the right atrium, is the dominant pacemaker of the heart and generates electrical impulses to stimulate the cells of the atria to contract; this is also known as atrial depolarization. The electrical impulse reaches the Atrioventricular (AV) node, located at the bottom of the right atria, which slows the electrical activity to the ventricles to allow the atria to fully contract and eject blood into the ventricles before the ventricles contract. This is also when the tricuspid and mitral valves close. The electrical activity continues quickly from the AV node to the Bundle of His and divides into the left and right bundle branches. The Bundle of His starts the ventricular depolarization and the ventricles contract as the electrical activity continues down the bundle branches to the ventricular muscle cells to cause the contraction. The activity continues from the bundle branches to the Purkinje fibers completing the contraction. This pathway is made up of large heart cells that conduct electricity quickly.

Normal ECG:
The ECG shows the electrical activity of the myocardial cells and produces the waves which we see by reading the depolarization and repolarization of the heart. The normal ECG reading, also known as a sinus beat, is composed of P, Q, R, S and T. The P wave starts at the SA node and is the beginning of atrial depolarization. The P-R interval is the conduction through the AV node where the Q-T interval is ventricular conduction. The QRS complex shows the electrical activity of ventricular depolarization where the T wave represents ventricular repolarization. Atrial repolarization happens as ventricular depolarization is occurring and is hidden by the QRS complex.

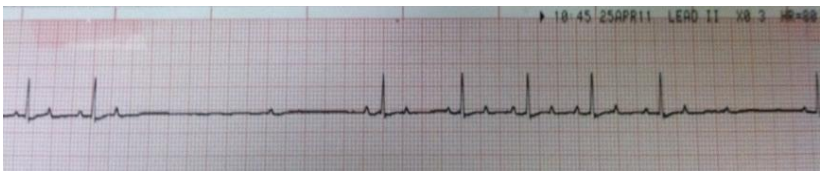
When assessing an ECG it is important to begin with identifying the P wave, the QRS complex and the T wave are all present. Is there a P for every QRS and a QRS for every P? Watch the speed, regularity, and the morphology of the complexes and watch the intervals of P-R, R-P and R-R. You can still tell the rhythm and get an idea if the ECG you are reading is normal even if you are not measuring it or using a 6 or 12 lead ECG machine.

Normal Arrhythmias:
Not all arrhythmias are dangerous or abnormal; although technicians do not make diagnoses, it is important to be able to recognize normal sinus rhythm and normal arrhythmias. Then you can recognize and alert the doctor of abnormal arrhythmias.

When assessing an ECG, first assess the heart rate of the patient. If the rate is faster than the normal rate for that species, then it limits the arrhythmias to tachycardic arrhythmias; such as sinus tachycardia, supraventricular tachycardia or ventricular tachycardia. If it is slower than normal heart rate then it is considered a bradyarrythmia and it could be a problem with pacing and the SA or AV node. If it is a normal rhythm and the QRS complexes are sinus beats, the arrhythmia is considered a sinus tachycardia or sinus bradycardia and it can be a normal finding. The normal rate is between 60 and 150 beats per minute (bpm) for dogs and 120-180 bpm for cats. This depends on patient species, activity or excitability level or non-cardiac diseases. If you find an irregular rhythm of sinus beats it is known as sinus arrhythmia and can be associated with respirations and wandering pacemaker. Finding a sinus arrhythmia is often a normal finding (usually faster on inhalation and slower on exhalation). However if it is found that the conduction is not normal, such as a gap between the P wave and QRS complex, then a block has occurred.

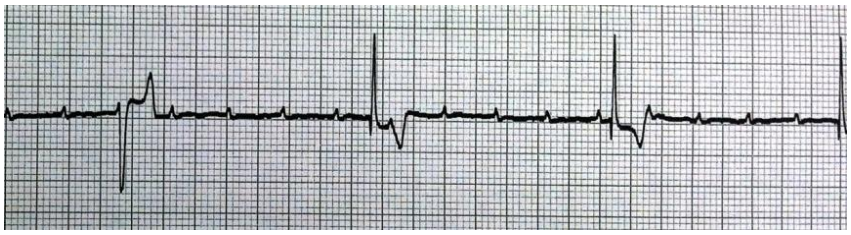
Second-Degree atrioventricular (AV) block occurs when the SA node fires but one or more of the electrical impulses are not conducted by the AV node resulting in a P wave without a QRS complex.

To make this a little more interesting, there are two types of second-degree AV block; Wenckebach Block and Mobitz type II block. A Wenckebach block the block is due to a block above or within the AV node showing a progressive lengthening of the PR interval until a QRS complex is dropped; where the Mobitz type II block does not show a successive lengthening in the PR interval. It is difficult to tell the two apart and unless you work with a cardiologist, just call it second-degree AV block. Symptoms may include weakness and syncope and can be seen during anesthesia but is usually asymptomatic. If treatment is necessary it usually consists of an atropine trial and some may mandate a pacemaker. It is rare but can lead to third-degree AV block.



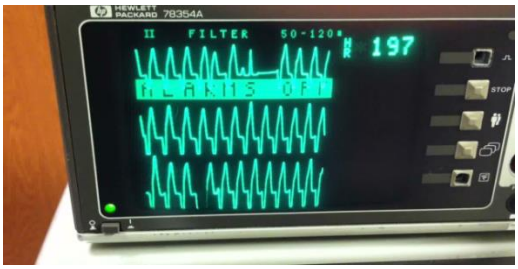
Third-Degree AV Block (or complete AV block) occurs when no atrial impulses makes it through to the ventricles. The ventricles contract by other pacemaking cells below the AV node but are not working in conjunction with the atria. The P waves are still present but

they may have no relationship with the QRS complex. These patients often exhibit symptoms of weakness and collapse and pacemakers are almost always required as this is a medical emergency.

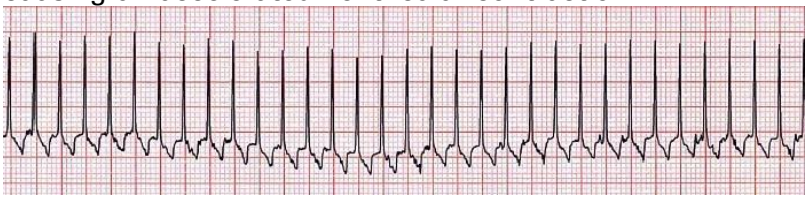


VPC- Ventricular Premature Contractions are the most common of the ventricular arrhythmias that occur and are a result of the ventricles contracting outside of the normal pathway. Due to the premature ventricular contractions, you will see wide complexes and the P wave is not seen. Often there is a compensatory pause between beats. When isolated, treatment is not necessary. However, when many appear or the heart rate increases, intervention may be necessary.

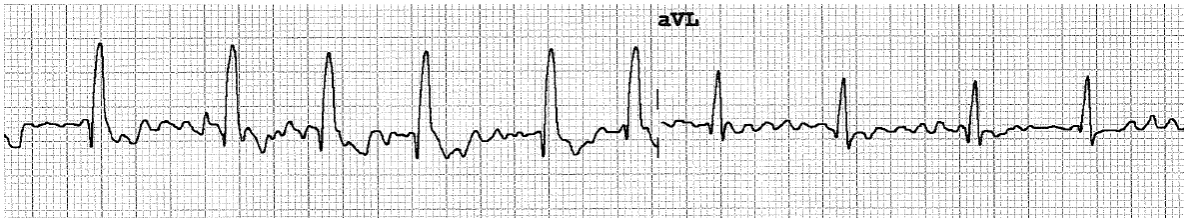
Rhythms with continuous VPCs are classified by heart rate and a run of three or more consecutive VPCs are put into two groups depending on heart rate. If the reoccurring VPCs are with a normal heart rate then it is accelerated idioventricular rhythm (AIVR). If the repeating VPCs are associated with a high heart rate then it is called ventricular tachycardia (VT). This is where the electrical rapid rhythms cause the ventricles to contract quickly, originating somewhere along the ventricles. There are many diseases (cardiac and noncardiac) that can cause VPCs, just to name a few: HCM, DCM, myocarditis, hyperthyroidism and gastric dilatation-volvulus (GDV), neoplasia, trauma, systemic inflammation and hemoabdomen. AIVR does not need to be treated if vitals are normal but if VT is present and persistent then treating canines with a loading dose of lidocaine and/or starting the patient on a CRI is warranted.



Supraventricular Tachycardia or SVT has a fast regular rhythm and narrow QRS complex with a P wave that may not be easy to identify. The electrical activity occurs before the AV node (above the ventricles) rapidly firing down the bundle of his and Purkinje fibers causing an accelerated ventricular contraction.



Atrial Fibrillation is where the electrical activity in the atria is disorganized due to muscle cells not firing in order. The AV node only lets a few of those impulses through, causing the QRS complex to show on the ECG as the ventricles are contracting but the rate is not regular. Treatment is lowering the heart rate with beta blockers or calcium channel blockers.



When observing a patient and their EGC, remember to ask yourself: is there a P for every QRS and a QRS for every P? How is the Rate, Rhythm and morphology? And how is the patient? Get to know your equipment, practice, and ask questions to keep learning.

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Abdominal Radiograph Interpretation: A Primer

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DoveLewis Annual Conference Speaker Notes

As technicians, nurses, and support staff, you often have to go through the hard physical work of taking radiographs without necessarily receiving the reward of a good understanding of the findings of that radiograph. While many veterinarians welcome an opportunity to teach and share their findings when asked, there simply is not always time to circle back and revisit cases that left the hospital hours or days ago. Using a few simple tips, you can directly reap the rewards of your labor by assessing images on your own. The goal of this primer is to help you learn those tips and have a handy resource until you become well practiced.

Know Your Densities

You are already well versed and trained in taking good radiographs – the landmarks to include, how to obtain the angles and exposure you desire – so that is not the information to expect here. Once you have obtained appropriate abdominal images, reading them begins with the basics of the different densities found on the images: air, fat, liquid, and mineral.

Air is black on radiographs – there is no resistance to the passage of the x-rays to the film so with more xrays passing through, the film becomes darker. You can use the black of the air around the patient to ensure that there are not exposure artifacts throughout the film. If there are lines or inconsistencies in that consistent, dark color that do not correspond to something attached to or beneath your patient (fluid lines, troughs, bedding) then there could be artifacts overlying your patient as well.

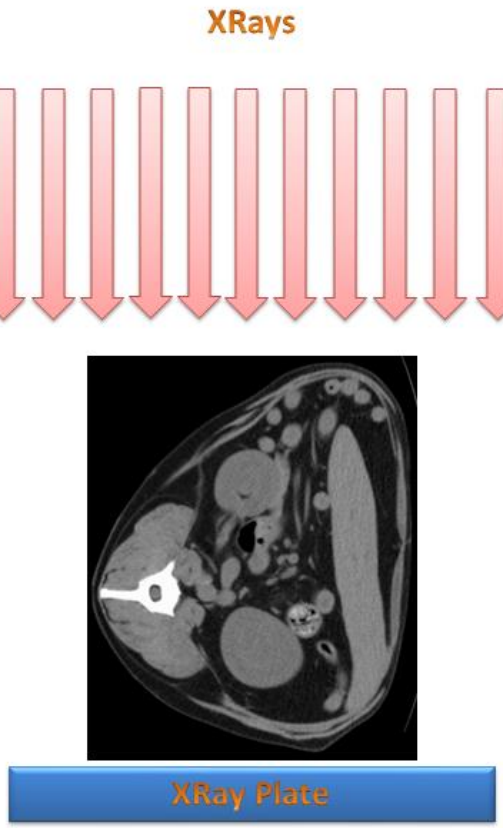
Fat is dark grey on radiographs and it is the reason that we see anything at all of interest on abdominal radiographs. The fat within the mesentery provides us with an outline of the serosal surfaces of the organs contained within the abdominal cavity. Fat is more radiodense than air but less radiodense than liquid and mineral, providing the contrast that we need to differentiate abdominal contents. This is why the radiographs of very thin patients are harder to read than those with normal body fat.

Liquid is a medium grey color on radiographs and its radiodensity is very similar to soft tissues and organs because they are composed primarily of liquid. Fewer x-rays can penetrate these tissues than fat and air so the color is lighter than those substances. Because soft tissues and organs are similar in appearance to liquid, when there is free fluid in the abdomen, the interface between the fat of the mesentery and the liquid density of

the organs is no longer present and this is why free fluid limits our view of abdominal contents.

Mineral varies from light grey to white on radiographs, depending on the type of mineral and its radiodensity. Those minerals that are more radiodense would include metallic materials such as surgical implants and intestinal foreign material. These will appear a stark white color on radiographs. Less radiodense materials like bone are a light grey color.

While knowing your densities is important, it is also important to remember that when x-rays are passing through your patient to your xray plate, they are rarely passing through just one type of tissue. This is always something to keep in the back of your mind when reading radiographs. It is part of our reasoning for taking orthogonal radiographs, reducing the error associated with overlying anatomy.



Know What to Look For

Easier said than done, right? Actually, when you are looking at radiographs, there are far fewer abnormalities to look for than you might think – you just look in a lot of different places for them. You will be looking for abnormalities of radiodensity, size, location, and shape. Once you have recognized that there is an abnormality, you can begin to work on possible causes for those abnormalities

Know the Norm
When you are assessing abdominal radiographs, you will be best served by systematically going through the image. The list of items to review that you will find in this section is extensive but as you get into the habit of looking at these areas, you will realize that for the most part you can assess each very quickly and can cover the majority of images in a minute or less. Once abnormalities have been identified, pondering the cause of those abnormalities may take much longer but the image assessment is quick!

When I look at abdominal radiographs, I take an outside – in – back out approach so these notes will walk you along the path I usually take. Find your own groove and change it if a different pattern works for you. Where relevant, throughout this section you will find small canine and feline normal radiographs helping to guide you to the normal location of each section. Larger reference images that match these small images can be found at the end of these notes.

Tissues Outside of the Abdomen
Subcutaneous fat, skin, and external genitalia are the most common extra abdominal tissues that are assessed with abdominal radiographs. In the normal case, these are generally consistent in radiodensity, more similar to the density of fat than liquid though the skin in particular can become closer to liquid density in some areas with end-on exposure.

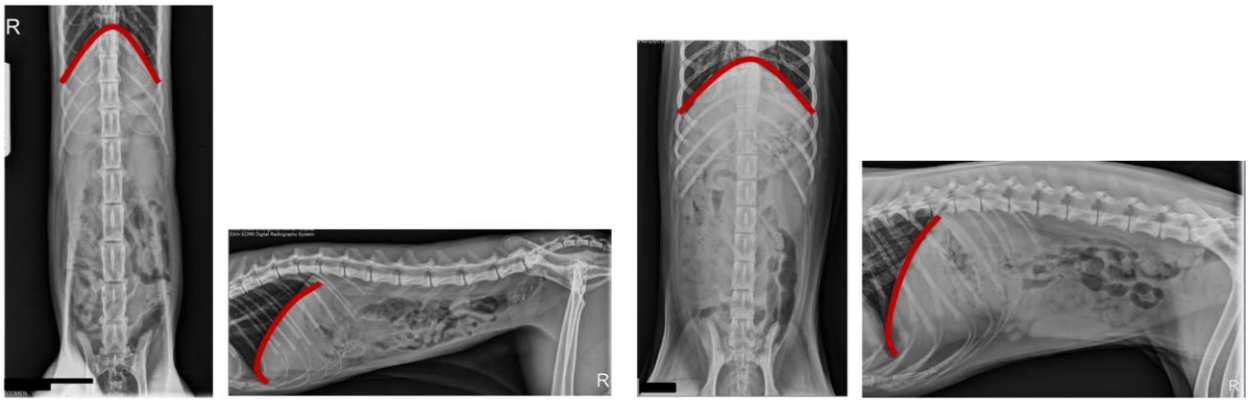
- Abnormal radiodensity – Abnormal radiodensity can indicate subcutaneous air or mineralization. Microchips may have migrated to a level where they are visible on abdominal radiographs. The penile urethra could have visible radiopaque calculi.
- Abnormal size – Animals that are obese may have very thick pads of fat on the back or ventral abdomen. Conversely animals that are emaciated or cachexic may have only a very thin layer of fat outside of their abdomen.
- Abnormal location – These tissues can be displaced in pathologic conditions such as abdominal wall herniation.
- Abnormal shape – Subcutaneous and dermal masses are the most common reason that we would find these tissues shaped abnormally.

Abdominal Wall
The abdominal wall is best assessed ventrally on a lateral radiograph and on each side of a ventrodorsal or dorsoventral projection. In the normal case it will present a thin continuous line from xiphoid to pubis or from the caudal-most rib to the pelvis. Because it usually interfaces with subcutaneous and intra-abdominal fat, this line is usually visible even though it is a thin layer of muscle and connective tissue.

- Abnormal radiodensity – This will not be a common finding in this area but can be noted with foreign material such as stainless sutures placed in the linea.
- Abnormal location – Animals that are particularly obese can have fat causing apparent displacement of the abdominal wall. Traumatic avulsion of the abdominal wall from the pubis can also occur.
- Abnormal shape – Most frequently when assessing the abdominal wall on radiographs, we are looking for abnormalities of shape – discontinuity of the line that may represent herniation of the abdominal wall.

Diaphragm

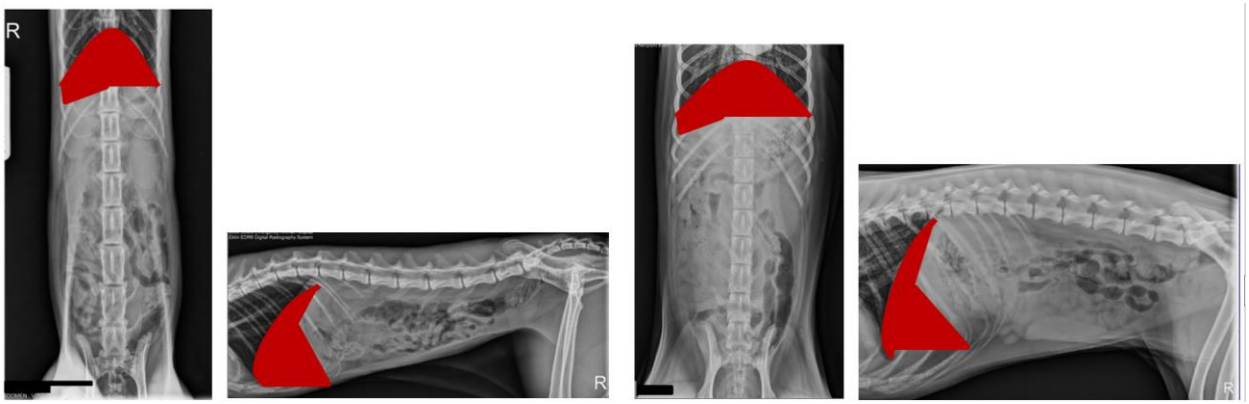
The diaphragm demarcates the abdomen from the thorax. Left and right lateral views highlight different parts of the diaphragm and can be used to better characterize any abnormalities that are noted. The diaphragm itself is a thin muscular layer and is not generally visible on radiographs. What is visible is the interface between the air in the thorax and the soft tissue of the cranial abdomen.



- Abnormal radiodensity – If there is free air in the abdominal cavity, then the diaphragm will commonly become visible because of the gas/soft tissue/gas interface. This can be pathologic as with rupture of a viscous or it can be iatrogenic as with post-operative free peritoneal air.
- Abnormal location – The lack of full demarcation between abdomen and thorax can be an indication of herniation of the diaphragm. The majority of diaphragmatic hernias are traumatic in nature though pericardioperitoneal diaphragmatic hernias are always congenital.

Liver

The liver is a large, solid appearing organ in the cranial abdomen with smooth edges. It appears to be a solid organ even though we know it is a multi-lobed organ because it has primarily small amounts of peritoneal fluid between the liver lobes and little in the way of fat deposits.

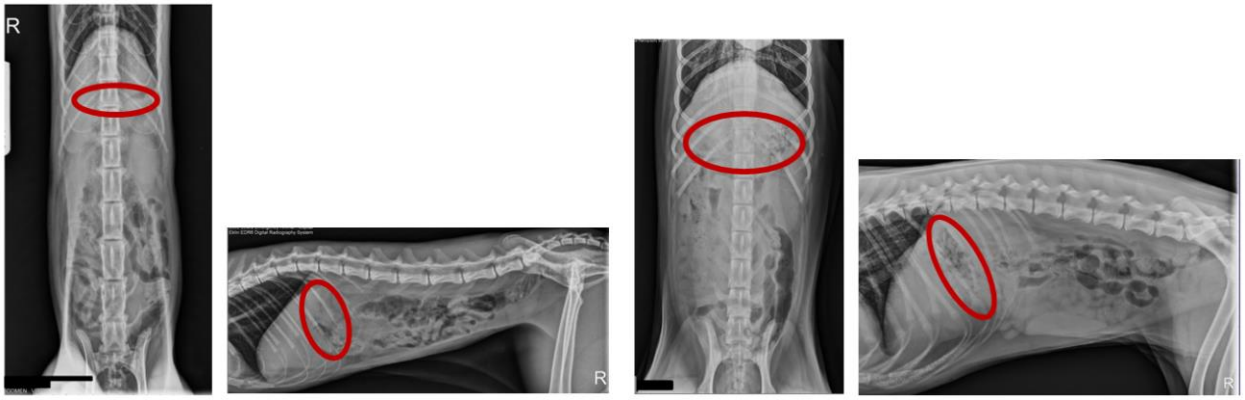


- Abnormal radiodensity – Mineral density within the liver could be an indication of calcification of the liver or biliary tract while air density within the liver can be an indication of abscessation or infection.
- Abnormal size – The liver usually rests primarily under the ribs. When it becomes enlarged, it may displace the stomach and small intestines dorsally and caudally or in some conditions it may extend significantly past the ribs ventrally. When it is smaller, it can be a normal variant for a patient or can be an indication of chronic hepatitis, cirrhosis or a shunt.
- Abnormal location – If the liver is located in the pleural or pericardial space then there is very likely a problem with the diaphragm. This is the most common type of displacement seen.
- Abnormal shape – Rounding of liver margins can indicate infiltrative lesions while masses or nodules that protrude abruptly from the parenchyma can also be identified on radiographs in some cases. In some patients a full gall bladder can protrude slightly from the ventral liver and should not be confused for a mass!

Stomach

The stomach is found just caudal to the liver, transversely on a VD projection and along a similar orientation as the caudal ribs on a lateral projection. Its appearance is highly variable depending upon its contents – ranging from a small J-shaped organ with visible rugal folds to a large, round organ occupying half or more of the abdomen with any variety of contents. Because there is usually both fluid and air within the gastric lumen, it can have very different appearances depending on the orientation of the image.

In the right lateral projection, gas rises to the fundus and body of the stomach while fluid drops into the pylorus. In the left lateral projection, gas rises into the pylorus and fluid falls into the fundus and body of the stomach. On the ventrodorsal projection, gas will often rise into the pylorus and fluid will drop into the fundus and body as well. While some favor three view abdominal radiographs and there may be some conditions for which this type of study is indicated, a recent study shows that there is no evidence to support three-view over two-view abdominal radiograph studies when making decisions about surgical intervention.

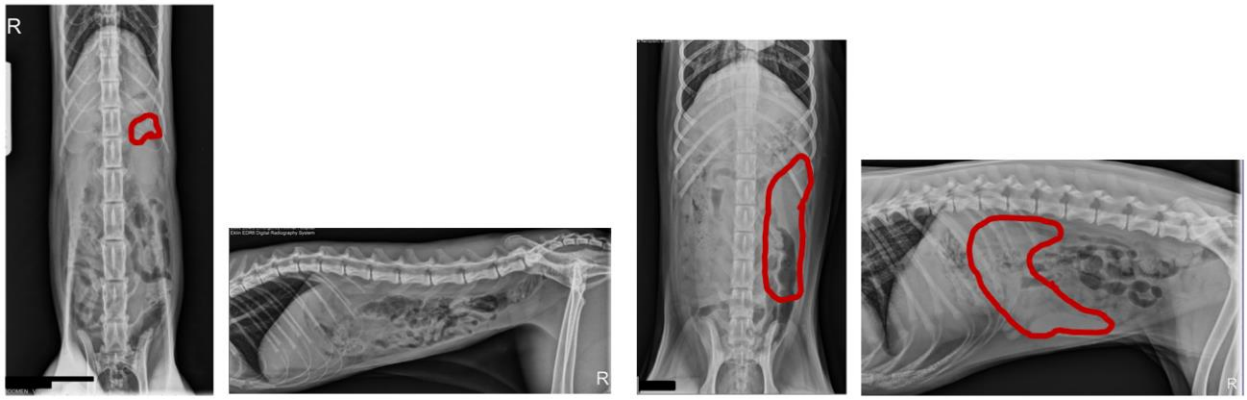


- Abnormal radiodensity – Gastric contents can be just about any density depending upon the dietary decisions of the patient. The gastric wall itself can develop small air bubbles in the presence of gastric necrosis.

- Abnormal size – As a highly elastic organ, it can be difficult to determine just what size is normal and what is abnormal. Ultimately, assessment for abnormal size will depend upon history and discussion with the owner to determine how much of what was ingested to gauge whether the stomach is larger than expected. Gastric dilatation with volvulus is a common veterinarian emergency in which the stomach is both enlarged and the pylorus is dorsally displaced on radiographs.
- Abnormal location – As with liver that has migrated into the pleural or pericardial space, any time that the stomach sees similar migration it is an indication that there is a problem with the diaphragm. If the stomach is dorsally or caudally displaced then it is usually because the liver is abnormal or enlarged.
- Abnormal shape – For the most part, the stomach is a malleable tube that takes on the shape of its contents. One of the biggest tricks it plays on a novice reader of radiographs is found in the right lateral projection. In this projection, when the fluid drops down into the fundus, it will sometimes leave the impression of a perfectly round, soft tissue density foreign body ventrally.

Spleen

While the spleen is a diminutive organ in the feline, rarely even visible on a lateral projection, it can be quite the opposite in our canine companions. In both species it is a smooth margined organ found primarily on the left side of the body. In dogs the tail of the spleen is usually the most easily visualized part ventrally as there is much overlying tissue on this projection. In dogs the head is easier to see on the VD projection as the body and tail are overlying other tissues and organ systems.

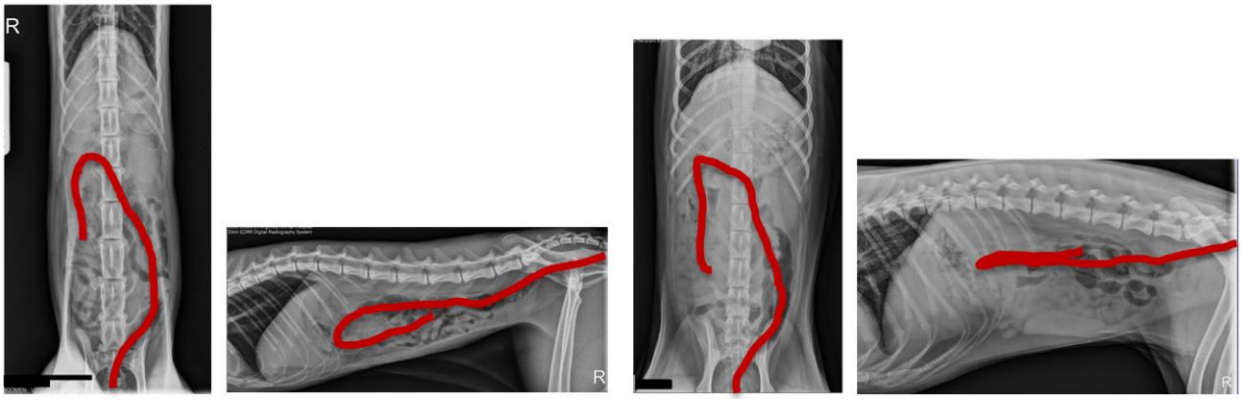


- Abnormal radiodensity – Mineral deposits in the spleen are rare and fat deposits are usually not visible on radiographs. Air density in the spleen could be an indication of an abscess.
- Abnormal size – The size of the spleen has to be carefully assessed because it can be quite variable, particularly with injectable sedatives that we often administer to facilitate taking radiographs. A very large spleen can be a normal variant for the patient, particularly the canine patient. A large spleen in a feline is more commonly pathologic and can be seen with neoplasia, reactivity, or extramedullary hematopoiesis.
- Abnormal location – The spleen is highly mobile so if it is in the wrong location it is likely because it is large, a neighboring organ is large, or it is a normal variant for the patient.

- Abnormal shape – Large splenic masses will sometimes be visible on radiographs and will be represented by deformity of the smooth margin of the organ. Small masses can be difficult to see on radiographs because of the size and orientation of this organ.

Large Intestines

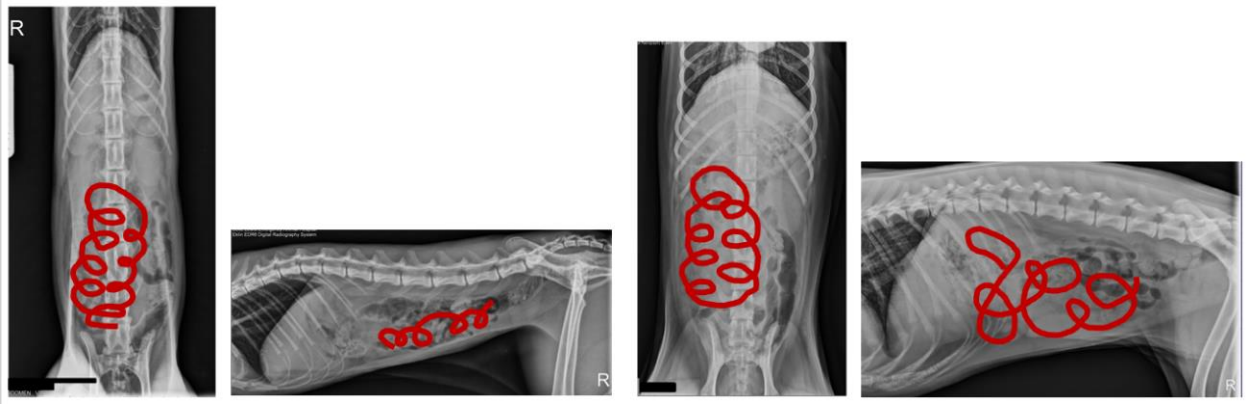
When it comes to the intestines, it is generally easiest to identify the large intestines first. They are, not surprisingly, normally larger in diameter than the small intestines. It is normal for the large intestines to contain a variety of liquid, air, and mineral consistency material depending on the consistency of the animal's feces.



- Abnormal radiodensity – The contents of the large intestines can have greater mineral opacity than anticipated if a patient has eaten bones or has become constipated.
- Abnormal size & shape – While the large intestines can normally have quite a large diameter and are elastic in their normal size, if they are significantly distended with mineralized contents then this could be evidence of constipation or obstipation. Segmental air distension of the colon along with focal narrowing can be seen with colonic torsion.
- Abnormal location – Displacement of the cecum is most commonly associated with colonic torsion. There can be ventral displacement of the colon in the presence of sublumbar lymphadenopathy. There is significant normal mobility of the large intestines otherwise. The colon sometimes appears to be ventrally displaced in the presence of large amounts of retroperitoneal fat.

Small Intestines

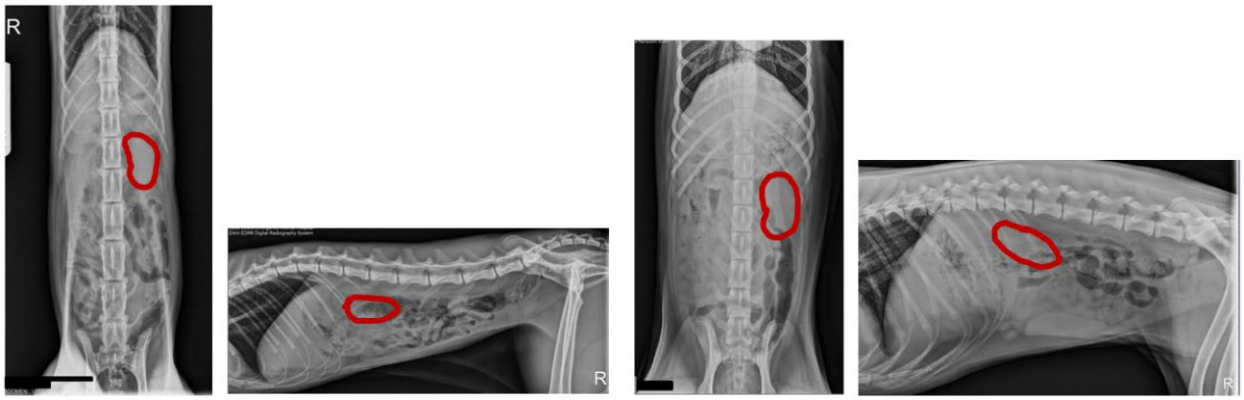
The small intestines occupy the majority of the rest of the mid abdomen. It is normal to see loops of small bowel dorsal to the stomach on the lateral projection in some dogs, particularly deep chested dogs. Part of the reason that we assess the large intestines before the small intestines is to make it easier to differentiate abnormally distended small intestine from normal large intestines. At times, it will not be possible to differentiate the location of a radiodense foreign body from small intestine or large intestine. In those cases, a pneumocologram can provide valuable information.



- Abnormal radiodensity – In the rare, lucky case, intestinal foreign material will have adequate gas or mineral density to be directly visible within the lumen of the small intestines. Chronic partial intestinal obstructions, commonly seen with intestinal neoplasia, will cause small intestinal distension with mixed soft tissue and mineral opacity to small intestinal contents orad to the abnormality. Do not be fooled by "thickened walls" to intestines – it is not possible to differentiate thickened intestinal walls from fluid within the lumen of those loops of bowel.
- Abnormal size – How can you compare the size of the intestines of a mastiff to those of a cat with the same ruler? Luckily each patient comes with its own built-in scale. By comparing the width of a loop of bowel to the height of the body of L5, we are able to standardize our assessment. Generally, if the small bowel is greater than 1.5 times the height of the body of L5 it is considered abnormal and if it is greater than 2 times the height of the body of L5 it is likely that surgical intervention is necessary.
- Abnormal location – As with many of the organs within the abdomen, there is great mobility with the small intestines. This same mobility means that enlargement of any other organ will compress the small intestines and potentially displace them. However, do not be fooled by obese animals – frequently the intestines will be shifted completely to the right of midline on the ventrodorsal projection by pads of retroperitoneal fat.
- Abnormal shape – Particularly with linear foreign bodies, the intestines can take on an accordion-like appearance, called plication. This will also be associated with small comma shaped gas bubbles within the lumen of the small intestines. Intussusceptions can sometimes be visible as a larger than normal loop of small bowel visible ventrally on the lateral projection.

Left Kidney

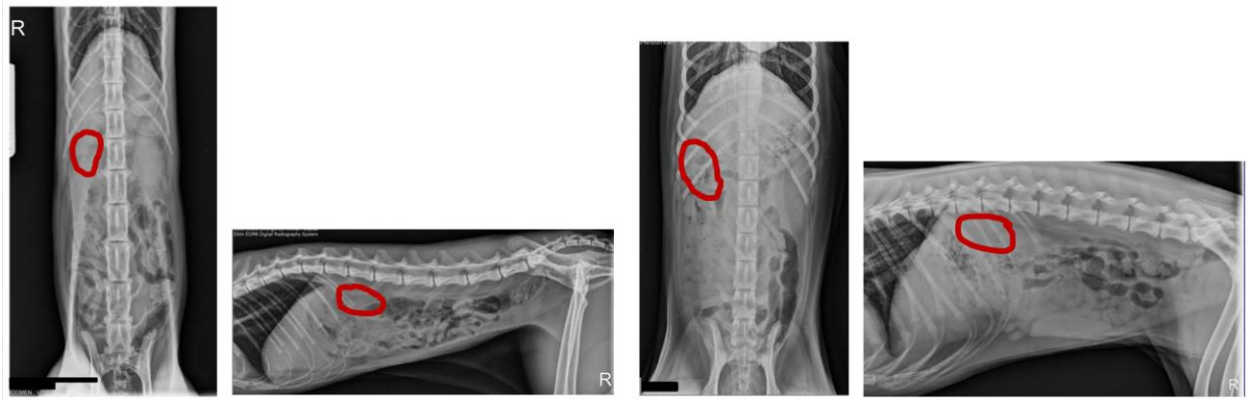
The left kidney is usually radiographically visible in both dogs and cats on the ventrodorsal projection. This organ will be variably visible on lateral projections depending upon the amount of retroperitoneal fat and any events developing within the intestinal tract.



- Abnormal radiodensity – The most common abnormality we see in either kidney is the appearance of mineral density within the renal pelvis associated with renal calculi. Not all nephroliths are visible on radiographs.
- Abnormal size – Normal canine kidneys are 2.5-3.5 times the length of the body of the second lumbar vertebra (feline 2-3 times). Very small kidneys are commonly a consequence of chronic kidney disease or congenital malformation. Enlarged kidneys can range from normal hypertrophy (to compensate for poor or absent function in the other kidney) to infiltrative neoplasia to hydronephrosis secondary to ureterolithiasis.
- Abnormal location – Unlike other organs within the abdomen, the kidneys tend not to wander far from their primary location. Be aware that cats that have had renal transplantation may have the kidney transplanted into the ventral abdomen.
- Abnormal shape – Before deciding that the kidney is actually shaped abnormally, imagine looking at it in a variety of different orientations. The radiographically visible shape of a kidney can be highly variable depending on its orientation at the time that the image was procured. If it is truly abnormal then the most common causes will be neoplasia, FIP, or cystic abnormalities.

Right Kidney

The right kidney is visible on the lateral projection for most dogs and cats though it is often overlapped by the left kidney. On the ventrodorsal projection in both species the right kidney can be challenging to identify completely. At times only the caudal pole of this kidney is visible. However, it is still important to look in the area where this kidney should be located to check for abnormalities. Abnormal findings for the right kidney are as listed above for the left kidney!



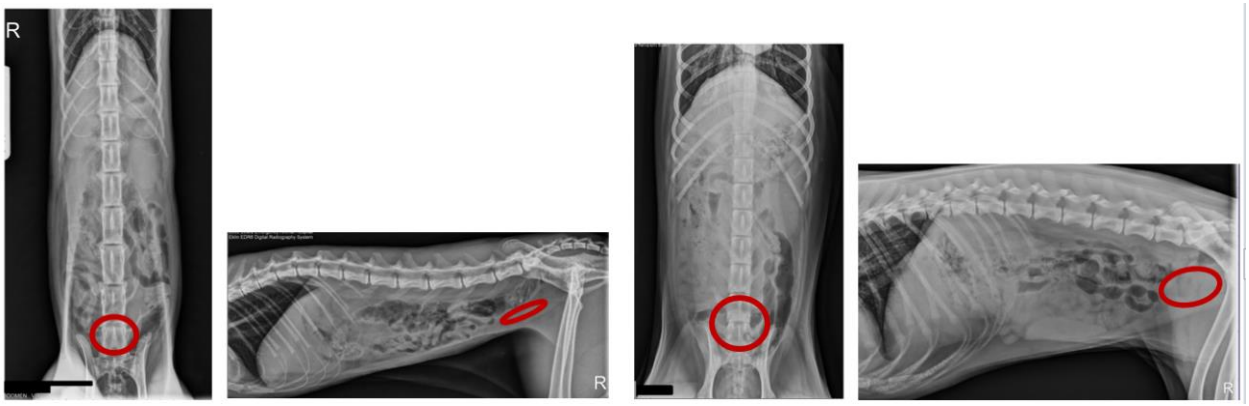
Retroperitoneal Space

While we are looking at the kidneys, we have an opportunity to assess the retroperitoneal space. This is the area where the kidneys and adrenals rest, proximal ureters and renal vessels pass, and there are generally significant sublumbar fat deposits. The duodenum, parts of the pancreas, colon, and rectum also border on this area but are less clinically significant when interpreting radiographs.

- Abnormal radiodensity – In this area we expect to see the kidneys and sublumbar fat primarily. A decrease in serosal detail of the kidneys is an indication of retroperitoneal fluid density and can be an indication of hemorrhage or urine leakage. Mineral opacity can be seen in the kidneys or ureters primarily. Air density can be seen in the retroperitoneum and when present is usually an extension of pneumomediastinum.
- Abnormal size – Obese animals will often have a large amount of retroperitoneal fat. This can cause ventral deflection of viscera.

Bladder

The urinary bladder is an elastic organ found in the caudoventral abdomen. It is generally slightly pear shaped, narrowing caudally as it transitions into the urethra.



- Abnormal radiodensity – Mineral opacity within the lumen of the urinary bladder can represent urolithiasis though not all uroliths are visible on radiographs. Neoplastic lesions at the neck of the bladder can also cause a light, patchy mineralized appearance. The wall of the urinary bladder can cause gas density of the urinary bladder of varying degrees.
- Abnormal size – Assessment of the size of the urinary bladder cannot be made solely from radiographs because of the elasticity of this organ. The visible size must be compared with urinary behavior and physical examination findings.
- Abnormal location – Perineal herniation can result in herniation of the urinary bladder into the perineum. Often contrast is required to definitively diagnose this condition. Traumatic avulsion of the abdominal wall from the pubis can also allow the urinary bladder to migrate into the subcutaneous space at the top of the left or right pelvic limb.
- Abnormal shape – The normal teardrop shape of the urinary bladder can become less defined in the event of rupture of the urinary bladder. However, this finding is not always present and should be relied upon to diagnose this condition.

Prostate
The prostate is a small, smooth soft tissue opacity associated with the urethra. It may not be visible in young or neutered dogs if the urinary bladder is empty. It is normal for the prostate to be more prominent in dogs that have not been neutered.

- Abnormal radiodensity – Mineral or gas opacity can be noted in either prostatic neoplasia or abscessation.
- Abnormal size – In mature, neutered dogs, the prostate may be very small and difficult to see on radiographs. Prostatic enlargement can be caused by benign prostatic hyperplasia, abscessation, cysts, or prostatitis. The prostate can at times become dramatically enlarged!
- Abnormal location – It is normal for a small prostate to pull up into the pelvis when the urinary bladder is empty. The prostate can herniate into the perineum but must be differentiated from paraprostatic cysts.
- Abnormal shape – The shape of the prostate can become irregular with prostatic neoplasia and cysts.

Peritoneum
Realistically, the peritoneum is the first thing assessed on a radiograph but it is also the last on the list. Remember that abdominal detail is made possible by the interface between liquid/soft tissue density, fat density, air density, and mineral density. Assessing the peritoneum involves looking for overall abnormalities in this whole picture. As the peritoneum is generally the lining of the abdomen and viscera, it is primarily assessed for radiodensity.

- Abnormal radiodensity – In the presence of free abdominal fluid, the interface between soft tissues and mesenteric fat is obliterated and the interpreter of the radiograph will appreciate a decrease or complete loss of serosal detail – depending on the degree of fluid present. However, there is a similar appearance in patients that have decreased intra-abdominal fat such as puppies, kittens, or cachexic animals. Any gas opacity within the abdomen cavity should be contained within the viscera. Free gas is evidence of ruptured gastrointestinal tract, abscessation, abdominal wall compromise, or recent surgery.

Know Where Things Live
There are many parts of the abdomen that have the potential to be visible on abdominal radiographs but are not readily visible in the normal patient. It is important to know where these are because it can help you to determine the cause of changes on a radiograph that you cannot otherwise explain.

Pancreas
The pancreas rests between the caudal stomach and the medial duodenum. In animals that have pancreatitis or pancreatic neoplasia, there can be a loss of serosal detail focally in this area on either ventrodorsal or lateral radiographs. Inflammation in this area can also cause a widening of the angle between the stomach and duodenum.

Gall Bladder
The gall bladder is nested between the lobes of the liver and not visible when normal. A full gall bladder can appear as a bulge ventral to the liver in the cat on the lateral projection. Biliary stones and emphysematous cholecystitis can cause mineral or gas opacity respectively in the right cranioventral abdomen.

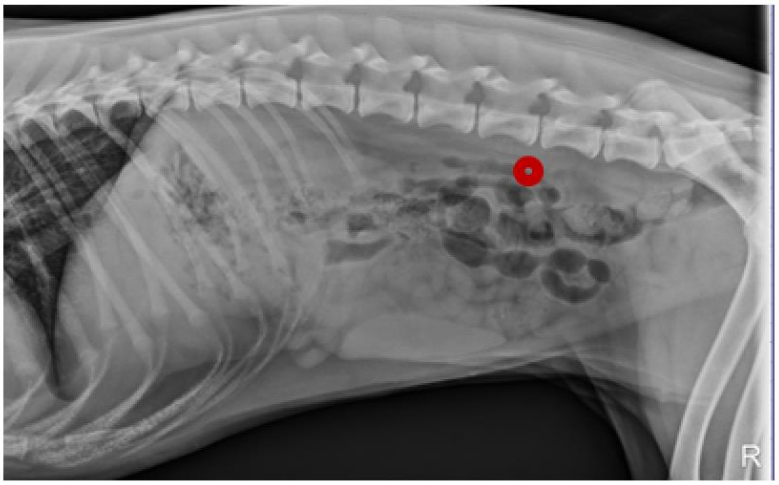
Lymph Nodes
The majority of intra-abdominal lymph nodes are not visible when normal. In particular, caudal sublumbar lymph nodes can become enlarged and easily visible on abdominal radiographs. This is usually secondary to primary or metastatic neoplasia.

Uterus & Ovaries
While you cannot see normal uterus or ovaries, the uterus in particular becomes very prominent at times. Pregnancy, pyometra, hydrometra, and mucometra are the most common causes of this change. The visible evidence of these conditions will usually be uterine enlargement. As the uterus enlarges, it displaces the small intestines toward midline and potentially grows to proportions much larger than anticipated from either small or large intestines. Around day 42, fetal mineralization will be visible on radiographs though these conditions can be differentiated sooner with other diagnostic modalities. Uterine gas opacity in pregnancy is most commonly associated with fetal death.

Ureters
While ureters are not visible normally, they can become visible with ureterolithiasis or ureteral dilation. They are primarily visible in the retroperitoneal space when visible but take care not to interpret the deep circumflex iliac arteries as ureteroliths. Their end on view amid retroperitoneal fat makes them readily visible in many animals on the lateral projection.

Adrenal Glands
The adrenal glands are located near the cranial end of each kidney medially. Calcification of the adrenal glands can be considered a normal finding in felines but is associated with neoplasia in canines. In addition, because the location of this calcification can vary slightly, it may be confused with nephrolithiasis on a lateral projection. Contralateral views will help to confirm the actual location of the mineralization.

Iliac Arteries
As mentioned above, it is important not to confuse the deep circumflex iliac arteries for ureteroliths. If there is an opacity visible in this area and it is not possible to rule out ureterolithiasis based on history, biochemistry, and physical examination findings then abdominal ultrasound can be used to assess for patency of the ureters.



Nipples
Unlike the other items on this list, nipples are commonly readily visible when assessing abdominal radiographs. For this reason, it is very important to consider whether a nipple could be involved in an abdominal opacity that just makes no sense otherwise. If necessary, the nipple can be marked with an external device and the radiograph retaken to rule out a nipple as a cause of an abdominal radiograph abnormality.

Things You Were Not Looking For
Part of being a responsible interpreter of radiographs is looking at all of the information you have available. In order to take an excellent quality abdominal radiograph, you had to include other parts of the body and it is actually important to look at those areas as well. Incidental findings may or may not be clinically significant today but nobody likes to look back on last year's radiographs and see that an early diagnosis was missed!

Caudal Thorax
The caudal thorax usually provides a small window of pulmonary parenchyma and pleural space for assessment. From an abdominal radiograph, you may be able to see evidence of an abnormal pulmonary pattern or pleural space disease. This would lead you to take thoracic radiographs for follow up.

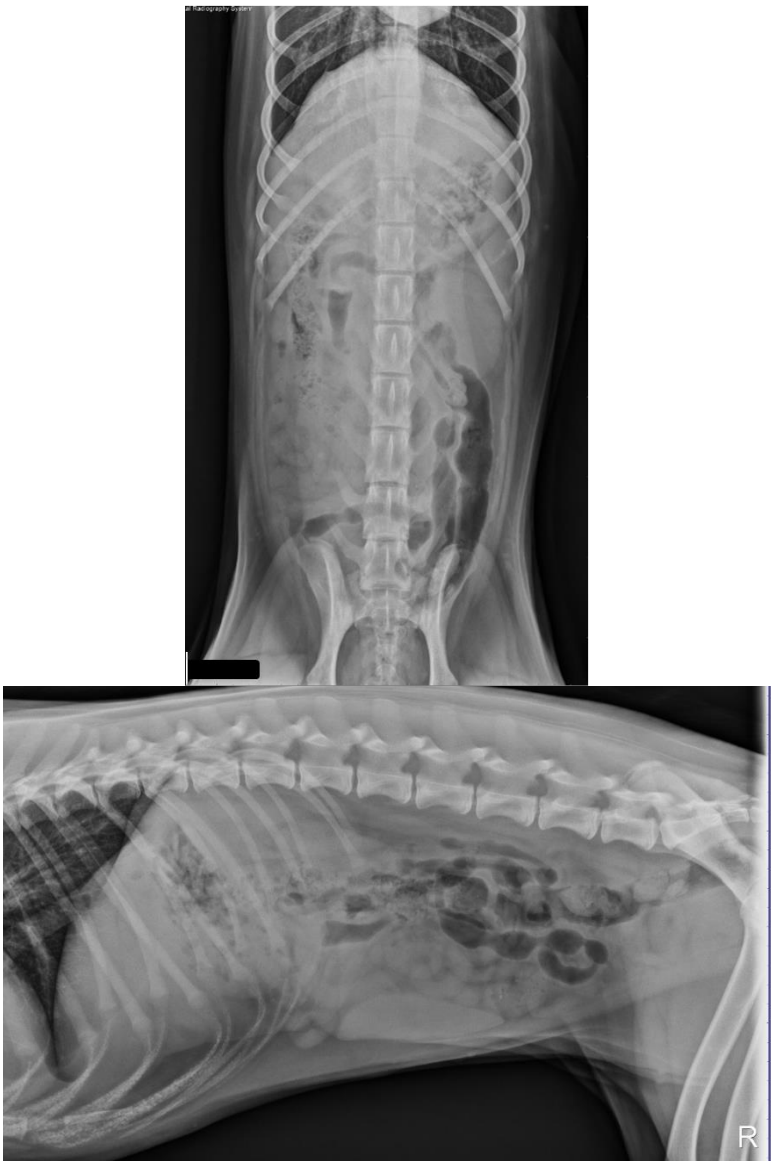
Esophagus
Along with the pulmonary parenchyma and pleural space, the caudal esophagus is generally visible in abdominal radiographs. Megaesophagus, esophageal foreign bodies, and hiatal herniation can be readily visible on abdominal images.

Cardiac Silhouette
Varied degrees of the cardiac silhouette are often visible on abdominal radiographs. Left sided heart enlargement and a globoid cardiac silhouette can both be tentatively diagnosed based on abdominal radiographs.

Vertebral Column

Lumbar vertebrae and intervertebral discs are readily visible on abdominal radiographs. These images can allow assessment for evidence of chronic or degenerative changes to the discs, spondylosis, or spondylitis.

Reference Images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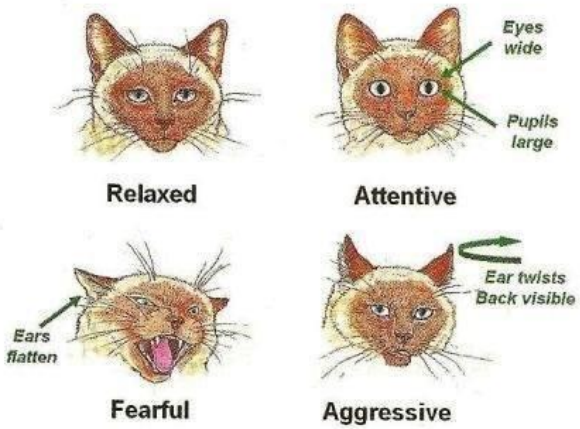
Make Your Job Easier by Understanding the Feline Patient

Becky Smith CVT, VTS (Clinical Practice-Canine/Feline)

DoveLewis Annual Conference Speaker Notes

- Cats are the most popular pet in the US, yet they visit the vet less often than dogs.
  - Cats visit the vet 0.7 times a year versus dogs that visit 1.6 times a year.
- Cats receive less preventive and veterinary care than dogs because:
  - Owners believe cats are independent and do not need preventive care.
  - Cats are great at hiding pain and illness, so owners do not realize they are sick.
  - Owners have a hard time transporting their cats to the vet.
- Cats are predators AND prey; this makes their behavior more complex then dogs.
  - Cats are predators of: rodents, small birds, fish, rabbits
  - Cats are prey of: dogs, large birds, foxes, raccoons, cougars
  - Cats are cautious and frequently on guard due to their size and being prey.
- F.A.C.T. = Free Access Crate Training
  - Training cats to accept their carrier at home will help with transporting them to the clinic.
  - Benefits of training:
    - Provides cats with a safe space (Fortress of Solitude)
    - Can help prevent territorial disputes among multi-cat households
    - Easier to transport the cat in their own space
    - Easy to teach children to give cats their own space when they have a carrier to go to
- M.E.M.O. = Multi-Modal Environmental Modification
  - Recommended by the Indoor Pet Initiative (indoorpet.osu.edu)
  - The ideal cat house includes:
    - Multiple litter boxes
    - Perches to view the environment
    - Safe hiding spots and places to sleep
    - Scratching posts
    - Toys to "hunt" (rotate them frequently)
    - Windows to look out
    - Quiet place to eat undisturbed
    - Bedding to keep comfortable
- All of the cat programs out there focus on understanding cat behavior and easing anxiety on the way to and in the clinic environment.
  - Cat-friendly Practice
  - Fear-free Certification

    - Low-Stress Handling
    - AAFP guidelines
- Fight or Flight Response
    - Given the choice, cats will run away.
    - Take away that choice and cats can become "aggressive" and fight back (it is life and death to them).
- In the clinic:
    - Take control of the carrier.
    - Do not allow owners to shake the cat out of the carrier.
    - Take the top off of the carrier, if possible.
    - Allow the cat to sit in the carrier or hide while getting a history.
    - Provide elevated perches to set carriers on in the lobby to avoid setting them on the floor.
    - Have a cat-only waiting area if possible.
    - Do not put your face up to the carrier!
    - Use Feliway infused towels to cover the top of carriers.
    - Don't scruff cats:
        - There are other options, this should not be the first option.
        - Do not lift cats by their scruff, it is painful to lift them by their neck and not support the weight of their body
        - Towel wrap, aka the "purrito", is your friend!
    - Medications:
        - Gabapentin 50-100mg per cat is standard.
            - Mild to moderate anxiety: give dose at least 2 hours prior to arrival in the clinic
            - Severe: give 1 dose the night before and another the next day 2 hours prior to arrival in the clinic
            - Mix with small amount of canned food
        - "Kitty Magic Lite"
            - Sometimes Gabapentin is not enough
                - Dexdomitor/butorphanol/ketamine
                    - 0.1ml each per 10# for easy dosing
                - Dexdomitor/butorphanol/midazolam
                - Dexdomitor/butorphanol
    - Socialize cats:
        - Kittens and older cats
        - Different options: toys, treats, canned food, petting, brushing
- Cats like routine:
    - If you disturb their routine, they no longer are in control and it will affect their behavior.
    - When hospitalized or boarding try to keep a routine for them:
        - Don't rearrange their kennel
        - Change bedding only if soiled
        - Have the same person treat them as much as possible
        - Cover the bottom of the kennel
        - Provide boxes for cats to hide in or perch on
- Understand feline facial and body language



Reading your cat's "body language"

Cats use different body postures to communicate their emotions. Below are some typical postures you may observe in your cat. When observing your cat, try to get an idea of its usual attitude when alone and in contact with other animals, including people. As cats become more anxious about their surroundings, they will try to avoid contact with threats. Their score may change very quickly depending on the seriousness of the threat. The highest scores usually are seen only when escape is not possible.

Score	Body Postures		Head Postures	
1 Relaxed	**Activity** – sleeping or resting, alert or active, may be playing **Body** – lying on side, on belly or sitting, if standing or moving: back horizontal **Breathing** – slow to normal **Legs** – bent, hind legs may be laid out; when standing extended **Tail** – extended or loosely wrapped; up or loosely down when standing		**Head** – laid on surface or over body; some movement **Eyes** – closed to open, pupils slit to normal size **Ears** –normal to forward **Whiskers** – normal to forward **Sounds** –none, purr	
2 Alert	**Activity** – resting, awake or actively exploring **Body** – lying on belly or sitting, if standing or moving the back is horizontal **Breathing** – normal **Legs** – bent, when standing extended **Tail** – on body or curved back, up or tense downwards when standing; may be twitching		**Head** – over the body, some movement **Eyes** – open normally, pupils normal **Ears** – normal or erected to front or back **Whiskers** – normal to forward **Sounds** –none or meow	
3 Tense	**Activity** – resting or alert, may be actively exploring, trying to escape **Body** – lying on belly or sitting, if standing or moving the back of the body is lower than the front ("slinking") **Breathing** – normal **Legs** – bent, hind legs bent and front legs extended when standing **Tail** – close to body, tense downwards or curled forward; may be twitching when standing		**Head** – over the body or pressed to body, little or no movement **Eyes** – wide open or pressed together, pupils normal to partially dilated **Ears** – erected to front or back **Whiskers** – normal to forward **Sounds** – none, meow, or plaintive meow	
4 Anxious	**Activity** – alert, may be actively trying to escape **Body** – lying on belly or sitting, if standing or moving the back of the body is lower than the front **Breathing** – normal or fast **Legs** – under body, bent when standing **Tail** – close to the body; may be curled forward close to body when standing. The tip may move up and down or side to side		**Head** – on the plane of the body, little or no movement **Eyes** – wide open, pupils dilated **Ears** – partially flattened **Whiskers** – normal to forward or back **Sounds** – none, plaintive meow, growling, yowling	
5 Fearful	**Activity** – motionless, alert or crawling **Body** – lying on belly or crouched directly on top of all paws, may be shaking. If standing the whole body is near to the ground, may be shaking **Breathing** – fast **Legs** – bent, when standing bent near to surface **Tail** – close to the body, curled forward close to the body when standing		**Head** – near to surface motionless **Eyes** – fully open, pupils fully dilated **Ears** – fully flattened **Whiskers** – back **Sounds** – none, plaintive meow, growling, yowling	
6 Terrified	**Activity** – motionless and **Body** –crouched directly on top of all paws, shaking, hair on back and tail bushy **Breathing** – fast **Legs** – stiff or bent to increase apparent size **Tail** – close to body		**Head** – lower than the body **Eyes** – fully opened, pupils fully dilated **Ears** – fully flattened, back on head **Whiskers** – back **Sounds** – none, plaintive meow, growling, yowling, hissing	

- Engage on social media with clients:
    - Dogs get a lot of attention on clinic Facebook and Instagram posts—don't forget the cats!

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