

EPILEPSY



CLINIC

The Epilepsy Clinic

- **What is The Epilepsy Clinic?**
 - The Epilepsy Clinic was designed to create a program focused exclusively on the management of the canine and feline epileptic. The Epilepsy Clinic will provide a volume of information for each pet owner regarding the management of their epileptic pet. We will also provide clear treatment and monitoring plans that will allow fast and accurate information to be communicated between Dr. Hass, your general veterinarian, as well as, any emergency doctors that may be involved in the care of the patient. The owner will also be provided a booklet of information that will allow them to better understand their pet's condition and the medications that are available to treat their epilepsy. Also monitoring forms will be provided to record seizure events, drug dosages and other notes. The forms can then be forwarded to The Epilepsy Clinic by fax, e-mail or post and each pet's file will be updated and their progress monitored on a regular, monthly schedule.
- **How will the care provided at The Epilepsy Clinic help my pet?**
 - The key to successfully managing an epileptic is to achieve a prompt and accurate diagnosis, initiate treatment and provide accurate and complete owner education. By educating and regularly communicating with the owner we hope the pet will be better regulated and have a healthier life and be a better companion to the owner. These goals are achieved in the following manner:
 - Identify the cause of the seizures.
 - Apply appropriate treatment for any underlying cause.
 - Minimize the frequency and the severity of the seizures.
 - Utilize anticonvulsants in such a way to minimize the side effects of the medications
 - Educate the client regarding (1) status epilepticus (30 minutes of continuous seizure activity or two or more sequential seizures without recovery of consciousness 1993, Epilepsy Foundation of America's Working Group on Status Epilepticus) and (2) the effect of uncontrolled or poorly controlled seizure activity. The term uncontrolled seizure activity does not just refer to status epilepticus or even cluster seizures, but seizure activity that occurs frequently because of inadequate medical management.
 - What happens when seizures are uncontrolled?
 - Kindling – Recurrent neural excitation can then recruit other areas of the brain to excite and create seizure activity. Also, changes in the fields

surrounding the neurons can assist in promoting abnormal electrical activity and seizures.

- Neuro-chemical events – during a seizure a variety of biochemical events occur as a result of excessive neural activity, altered perfusion (blood flow) and decreased oxygenation. These events may not cause any immediate or observable changes in your pet. However, over time they may contribute to the development of more refractory (difficult to control) seizures and altered behavior.
- Have realistic expectations regarding the management of the epileptic
 - Most veterinary patients that suffer from epilepsy and are placed on anticonvulsants do not experience a complete resolution (cure) of their condition. However, the frequency and severity of their seizures should be diminished and their long term prognosis and quality of life should be positively impacted.
 - Despite adequate dosing and therapeutic blood levels, approximately 25-30% of idiopathic epileptic dogs are poorly controlled with the commonly used anticonvulsants, Phenobarbital and the bromides. These patients benefit from the use of less commonly administered anticonvulsant agents and the adequacy of the patient's long term management may hinge on identifying promptly that the patient needs to change therapies.
 - Through the benefit of Dr. Hass' training and experience you and your pet will be provided with access to the most recent advancements in diagnostics, therapeutics, and long term support and management of your epileptic pet.



- **About Veterinary Care Specialists.....**
 - Veterinary Care Specialists (VCS) was conceived and developed over a five year period culminating in its opening in December of 1997. After having worked in a number of universities and private referral settings, Dr. Hass and her partner, Peter Barnes, wanted to develop a practice that strongly emphasized the relationship between doctor, patient, support staff and client (pet owner). It was not their goal to be a large, impersonal practice, but to develop and maintain a practice philosophy that emphasized patient care, communication and excellent medical practice. As with any community of individuals, we have grown and developed over the years. All of us at VCS take pride in our accomplishments.

- **Julie A. Hass DVM, MS**
 - Dr. Hass is a 1986 graduate of the Michigan State University College of Veterinary Medicine. After graduation she entered a small animal medicine and surgery internship program at the Virginia-Maryland Regional College of Veterinary Medicine in Blacksburg, VA. Upon completion of her internship Dr. Hass began her residency training in veterinary neurology at The Ohio State University. The residency at OSU emphasized medical neurology with a focus on the management of epilepsy. While at OSU Dr. Hass was a contributing author to Clinics of North America on epilepsy. Dr. Hass received her Masters of Science degree from OSU in 1990. Her Masters Thesis was entitled *Cytological, Biochemical, Single Radioimmunoassay, and Immunocytochemical Values for Cerebrospinal Fluid Collected by Atlanto-Occipital Puncture from Healthy Cats*. She completed her residency training at a private referral practice, Veterinary Referral Associates in Gaithersburg, MD, where she studied both medical neurology and neurosurgery. In 1992, Dr. Hass returned to Michigan working with two area referral practices as well as a number of emergency services before she assisted in developing Veterinary Care Specialists in December 1997. Dr. Hass has given presentations on a variety of topics in veterinary neurology to veterinary medical associations as well as breed associations, dog clubs, and animal rescue groups.

- **What is epilepsy?**
 - Epilepsy is a recurrent paroxysmal disorder of cerebral function marked by sudden, brief attacks of altered consciousness, motor activity, or sensory phenomena. Convulsive seizures are the most common form of attack Taber's cyclopedic medical dictionary, copyright 1997.
Epilepsy can be caused by a variety of conditions, all of which predispose the patient to the paroxysms of cerebral dysfunction (seizures). Therefore, if a patient suffers from epilepsy, the use of that term does not imply a particular health problem, but only describes one sign (or symptom) of their condition.

I find it more useful to initially discuss seizures and the potential causes of the seizures rather than the causes of epilepsy. The importance of being an epileptic is evident later when we begin to discuss the frequency and character of the seizures and the long term management of the patient.

Seizures can have a wide variety of causes, or etiologies. I like to divide the possible causes for seizures into the following categories.

1. Metabolic – This is one of the first categories that I consider since we can screen the patient quickly for a wide variety of metabolic causes through the minimally invasive technique of blood analysis. Examples of metabolic causes include: low blood sugar



(hypoglycemia),
kidney (renal)
failure,
electrolyte
disturbances,
liver (hepatic)
dysfunction, and
bleeding
disorders
(coagulopathies)
. Other

metabolic conditions that we may screen a patient for may include hypertension, or systemic infection (such as feline viral infections like FeLV, FIV, FIP or toxoplasmosis).

2. Traumatic- This cause for seizures is often self evident on initial examination. Remember that a traumatic event substantial enough to cause seizures usually is so substantial that it caused unconsciousness and/or a deformity to the skull. The thickness of the adult dog and cat skull and the way that the brain is attached within the skull protects the pet's brain from injury from most minor traumas. Some patients may experience brain trauma in utero (prior to birth), at birth or shortly after (when the skull is soft and pliable) of which the owner is unaware. These patients may have experienced a blow to the head, altered cerebral blood flow, or hypoxia that damaged an area of the brain. The area of damage may then become a focus, or origin, for the development of seizure activity. The defects caused by these types of injuries may be only evident on MRI or CT scan. Patients that have recently experienced brain trauma may require extensive care in hospital, oxygen therapy, treatment of associated wounds and radiographs, blood analysis, and possibly MRI or CAT scan.
3. Cancer (Neoplasia) – Tumors of the brain may be primary intracranial neoplasm's or they may result from the spread of a tumor from some where else in the body (this is called metastasis). Primary tumors of the brain typically grow slowly and do not tend to spread to other areas. Unfortunately, because they are growing

within a confined space (the skull) they can impinge on the surrounding normal brain tissue causing further dysfunction and progressive deterioration over time. Often times these patients will present with seizures as one of their problems.

Metastatic tumors of the brain are tumors that have spread from other parts of the body to the brain. These tumors are generally more quickly growing than primary brain tumors and there may be one or more sites within the brain where the tumor has begun to grow.

It is important to distinguish between primary and metastatic disease since each carries a different prognosis and therapeutic plan.

Neoplasia that is present outside the central nervous system may cause seizures without having spread directly to the brain. This is called a paraneoplastic syndrome. The exact cause for this condition is not completely understood.

Tests that may be recommended when neoplasia is a potential cause, or differential, for your pet's condition include: thoracic radiographs, abdominal or thoracic ultrasound, blood testing and MRI or CAT scan.

4. Primary or Idiopathic – The term idiopathic implies that there is no recognizable cause for the condition. When we are discussing epilepsy this term is used to describe patients that, after performing all appropriate testing (blood work, radiographs, CSF analysis and MRI for example), no underlying pathology can be identified.

These patients typically have a heritable form of epilepsy.

I also include patients with congenital, structural defects and old, traumatic insults in this group since the conditions are non-progressive and the patients are basically managed in the same manner as the primary or idiopathic epileptic.

Typically, patients with idiopathic epilepsy are between 6 months and 5 years of age.

Diagnostics that may be performed include blood analysis (this may include liver function testing and thyroid function testing), CSF analysis, MRI or CAT scan, viral panels and other testing for infectious causes, and radiographs.

5. Infectious and Inflammatory causes- Inflammation of the brain is called encephalitis. There are a wide variety of causes for inflammation of the brain. First, there are infectious causes like distemper virus, rabies virus, bacterial, parasitic and fungal infections. Then there are inflammatory diseases that are not caused by an infection, but cause an inflammatory response in the brain. Non-infectious inflammatory diseases of the brain include Granulomatous meningoencephalitis and Pug encephalitis to name a few.

Diagnostics that may be performed for a patient with encephalitis include blood analysis, radiographs, CSF analysis and sometimes MRI or CAT scan.

6. Vascular Disease – Hypertension, hemorrhage related to bleeding disorders, ischemia (poor blood flow), infarction (formation of a clot or blockage of a blood vessel in the brain) and other vasculopathies (possibly related to hyperlipidemia, increased fat in the blood) are just a few examples of conditions that may result in seizures and the development of epilepsy. Sometimes, when the underlying cause is treated the patient's neurological signs and seizures resolve and no other anticonvulsant therapy is warranted. In other cases, such as hemorrhage from trauma, the patient may recover, but be left with an area of damaged tissue that will serve as a focus of seizure activity for the rest of the patients life.
- The initial consultation – History, Physical examination and Neurological Examination
 - When you arrive with your pet, first, Dr. Hass will collect a complete medical history. Your general practitioner will be of assistance by providing documentation of previous medical records, blood testing, radiographs, etc. Bring any notes that you have compiled about your pets seizure history and any other observations that you have made. Once the history is adequately covered Dr. Hass will perform complete physical and neurological examinations. These examinations will be performed with you present. A retinal examination will be performed in the course of her neurological examination and if your pet is a dog, Dr. Hass will ask you to walk your pet. Cats will also be observed for any deficits in their gait and coordination by allowing them to roam about the exam room.
 - **Diagnostic Testing**

If Dr Hass feels that additional testing is necessary for your pets condition one or some of the tests described below may be recommended. The test descriptions are provided as a quick reference so you might further appreciate why tests are recommended and what is involved.

- Laboratory Tests



- A variety of blood tests may be recommended. Different diagnostics may be recommended for each patient based on tests previously run and differentials (possible causes) that may be considered for your pet. Listed below are some of the more common laboratory tests and some of the information that is collected through interpretation of the results.
 - Chemistry panel
 - A complete chemistry panel looks at values such as blood sugar, electrolytes (sodium, chloride, potassium, calcium, phosphorous), liver enzymes (remember the liver enzymes do not evaluate liver

function), protein levels, kidney function, pancreatic enzymes, and cholesterol, to name a few. Complete chemistry panels should be run on an annual basis for any epileptic that is on anticonvulsant therapies. Often a full chemistry panel will be evaluated after the first seizure, to help rule out any metabolic disease. If abnormalities are identified, then repeat testing and additional diagnostics may be recommended.

- CBC
 - CBC stands for complete blood count. A CBC identifies values for the red blood cell count, white blood cell counts and differentiation and quantification of the types of white blood cells present, and platelet count.
- Urine analysis
 - A urine analysis is a test performed on urine that allows us to look for evidence of urinary tract infections or blood in the urine and quantitate the patient's ability to concentrate urine, as well as protein, ketone and glucose levels.
- Thyroid testing
 - Thyroid hormone acts within the central nervous system. Derangements in thyroid function then can contribute to abnormal brain function. It is very rare for hypothyroidism (low thyroid) to be the sole cause of seizures. However, if a patient has a predisposition to seizures and they are hypothyroid, their seizure disorder may be more difficult to manage unless the thyroid deficiency is corrected. Also, certain drugs will cause artificial lowering of thyroid values on routine testing (Phenobarbital for example). It is of value to establish base line thyroid values prior to initiating long term treatment with these drugs.
- Bile acids testing – pre and post prandial
 - Pre and post prandial bile acids testing is utilized to document hepatic (liver) function. Bile acids testing is recommended when hepatic dysfunction is suspected or to document normal hepatic function prior to initiating a medication that is metabolized by the liver and may cause hepatic damage and subsequent dysfunction after prolonged use (like Phenobarbital)
- Anticonvulsant blood levels

- Anticonvulsant blood levels can be performed easily for Phenobarbital and Bromide. Felbamate and other anticonvulsant blood levels may be monitored as well, but most have a high margin of safety and rarely causes toxicities.
- Radiographs (X-rays)
 - Radiographs may be recommended to define your pet's condition. Radiographs are non-invasive and typically the patient does not need to be sedated or anesthetized for routine radiography. Chest radiographs may be performed to look for evidence of metastatic disease (cancer that has spread from other areas of the body) or cardiopulmonary disease. Abdominal radiographs may be recommended. Radiographs of the abdomen may be used to assess hepatic, renal, splenic size and shape and to look for abnormal masses.
- Ultrasonography
 - Ultrasound is a non invasive technique for examination of the organs within the chest and abdomen as well as even tendons, vasculature and soft tissues of the head, neck and appendages. Ultrasonography is performed by using sound waves that bounce off tissues and then record the characteristics of the waves that return to an instrument called a probe. Ultrasound is used to further characterize changes in organs that may have been identified on blood analysis or on radiographs. Sometimes, based on what is observed on ultrasound, a biopsy of an abnormal organ may be performed. Ultrasound guided biopsies can prove to be very diagnostic and minimally invasive. *** At VCS, unlike other referral hospitals, an ultrasound is performed by a highly trained, registered ultrasonographer and then the images are reviewed by our critical care specialist. All the information accumulated is then reviewed with Dr. Hass. Your pet has the benefit of a number of trained professionals whenever an ultrasound is performed.
- Neuro-Imaging
 - Imaging or visualizing the central nervous system can be very challenging since the brain and spinal cord are incased in bone. This means the regular radiographs and even ultrasound cannot allow visualization of the brain. Ultrasound may only be utilized when a defect is present in the skull. With the advent of MRI and CAT scans we have the ability to visualize the structure and other characteristics of the tissues of the brain. Tumors, hemorrhage, inflammation, vascular defects, and congenital structural defects, to name a few, can be appreciated through the benefit of these non-invasive techniques. The term non-invasive means that we do not have to enter into the nervous system with a needle or surgical instruments in order to gain a view of the brain and associated

structures. Patients do require anesthesia to immobilize them for these procedures. There is inherent risk associated with any anesthetic event. However your pet will be thoroughly evaluated to minimize these risks, anesthetic drugs will be chosen that are appropriate based on your pets condition, and your pet will be carefully monitored throughout the procedure. Dr. Hass will discuss with you any of the risks related to these procedures

■ MRI

- Magnetic resonance imaging (MRI) is an imaging technique using magnetic fields and radio waves



to create changes within the tissues being evaluated that then emits a signal that is recorded by a computer. Images are then created that represent very thin slices or sections of the area being evaluated. These slices allow detailed views

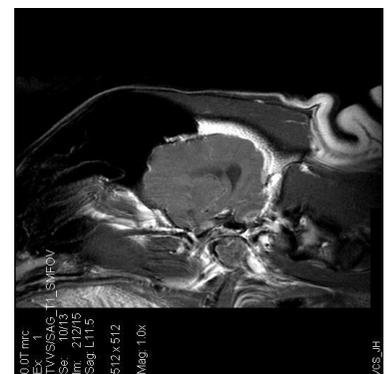
of the structure (in this case, the brain) one section at a time. The images then allow visualization of the architecture of the brain as well as characterization and evaluation of the tissues of the brain. This technique is non-invasive, but the patient must be immobile



(anesthetized) throughout the imaging study. In most instances, MRI is the preferred imaging technique to evaluate the brain and spinal cord.

■ CAT scan

- Computed axial tomography scan creates three dimensional images of a structure (in the case of our patients, the head) via the use of x-rays that are directed at the structure from multiple angles. A computer then takes the information generated by the x-rays and constructs an image of a



section or slice of that structure. This is repeated many times to create a three dimensional evaluation of the structure being studied.

○ CSF Analysis

- The cerebrospinal fluid (CSF) is a substance that circulates around and, on a limited basis, within the brain and spinal cord. It serves to provide protection of neural tissues as well as nutritive support. CSF within the central nervous system circulates and changes continuously as it is produced within the brain and reabsorbed into the venous system. CSF does not get exposed to all nervous tissue. Diseases effecting areas not exposed to the CSF may not cause significant changes of the spinal fluid from its normal values. However, pathology (disease) affecting areas of the brain and spinal cord that are exposed to the circulating CSF can cause changes in the established normal values for CSF in the dog and the cat. CSF is also isolated (like the brain and the spinal cord) from the circulating blood (this is accomplished by the blood brain barrier) and so it is typically protected from influences of diseases outside the nervous system. Therefore, a sampling of CSF can be an indicator of the health of the central nervous system. When CSF is analyzed the cellularity (CSF is typically has very few cells), the protein level (protein levels may be elevated with inflammation, tumors, trauma), and the glucose level are evaluated. Some times bacteria and fungal organisms can be visualized when the CSF is examined microscopically. Tests can be performed on CSF to look for viral infections and fungal infections.

CSF is collected by performing a cisternal (particularly when the patient is suffering from seizures) tap. The patient is anesthetized and a small area at the back of the head is clipped and surgically

prepared. Then the patient is positioned so that the doctor may insert a needle into an area called the subarachnoid space. This is the small area around the spinal cord that is filled with CSF. The fluid then flows from that space, through the needle, and into



- When should an epileptic be treated with daily anticonvulsant therapy? I recommend that we consider anticonvulsant therapy on a regular dosage schedule when a patient seizes monthly or more frequently, when they experience cluster seizures (one episode is sufficient) or if they have experienced status epilepticus. Also, if a patient seizes a single time, but some known pathology is present that triggered the seizure (such as a tumor or some other defect) I will recommend anticonvulsant therapy. The following list is a description of the commonly, and some times uncommonly, used anticonvulsants and their actions and side effects. Each epileptic is an individual that has a specific seizure history and presentation as well as an individualized response to medications. No one medication is ideal for all patients and sometimes it is a matter of trying different medications or combinations of medications before we find the right fit for your pet. It may take time to establish an effective protocol that has minimal side effects and can work within the structure of your family's schedule.

- Phenobarbital

- Phenobarbital is a barbiturate. It may be administered intravenously (IV), intramuscularly (IM) or orally (PO). Phenobarbital acts as a CNS depressant. It's mechanism of action is not completely understood. Phenobarbital is thought to act by mimicking or increasing the effectiveness of an inhibitory neurotransmitter called GABA. By increasing the inhibition of neural activity, Phenobarbital acts to suppress abnormal neural activity (seizures). The drug is metabolized in the liver and the remainder of the drug (25%) is excreted unchanged through the kidneys. By testing blood samples we are able to document the level (amount) of this medication in the patient's system. Once Phenobarbital administration begins it takes approximately 10 days for the patient to achieve a steady state blood level reflective of the patient's current dose. The time required to achieve a steady state blood level is dictated by the drug's half life.

Once the patient has reached a steady state level, studies have indicated that their blood level does not typically vary throughout the course of the day. Phenobarbital blood levels do not need to be taken just prior to a dose (called a trough level) unless we are having difficulty regulating a patient. Phenobarbital is dosed twice daily. In some instances certain patients may benefit from three times daily dosing.

Phenobarbital may be given IM to patients that are on the medication, but cannot take it orally in the hospital (for example: a patient that suffers from vomiting and cannot eat could be given IM Phenobarbital to maintain anticonvulsant drug levels and avoid abrupt withdrawal of the drug).

Phenobarbital is also administered intravenously (IV) to treat active seizing. If your pet has to be hospitalized due to frequent or lengthy seizures, Dr. Hass or your general practitioner may recommend IV Phenobarbital to 'break' a seizure cycle. Patients may remain sedate and non-ambulatory (not walking) for up to 24 hours after receiving an IV Phenobarbital treatment to stop seizure activity.

Side Effects: Many side effects may be transient. As the length of time the patient is exposed to the drug increases, most patients become more 'tolerant' and side effects become less severe.*** Since Phenobarbital causes depression of the central nervous system and accentuation of the effects of inhibitory neurotransmitters, it is only logical that a patient taking this drug can be more sedate. Additional side effects include: polyphagia (increased hunger), polydipsia (increased thirst), anxiety/agitation, ataxia (wobbliness), elevated liver enzymes and bone marrow suppression.

Remember, communication and careful adherence to dosing instructions is vital to the success of any medical therapy. As with any medication that is prescribed for your pet, it is important that you are observant and if you feel your pet is experiencing an ill effect or the drug is not successfully managing your pet's condition you should contact the doctor that prescribed the medication immediately.

- Bromide (Potassium or Sodium)
 - Bromides are very old medications that were administered to people for sedation and as an anticonvulsant. In the 1980's veterinary medicine 'discovered' these drugs and their beneficial use in dogs and cats. Potassium and Sodium Bromide are salts. They dissolve in water. There is more bromide in sodium bromide than in potassium bromide per grain of compound. The Bromides are given **only** orally. This medication is typically dispensed as a liquid (sometimes flavored) or in capsule form. Since the bromides have a bitter taste and can cause gastric upset we recommend that the drug be given with food. The mechanism of action for these drugs is not well understood, but is suspected that the negatively charged bromide ion replaces chloride at a cellular level in the nervous system. This results in the hyperpolarization of neurons making them refractory to depolarization (the event that precedes a seizure). Bromides are absorbed through the gastrointestinal tract and excreted predominantly through the kidneys, although the exact pharmacokinetics has not been identified. Bromide has a long elimination half life. Therefore, on a maintenance daily dose it will take 90 days to achieve a steady state blood level. This long delay between starting the medication and steady state can be

shortened by a dosing regimen referred to as loading. Loading is a process of administering an elevated dose of the medication over a 5 day period, followed by introduction of the 'maintenance' dose. 10 days after initiating the loading dose we can check a blood level of the drug and find the drug level that was achieved by loading. Then one month later another blood level should be evaluated to see if the drug level has been maintained on the maintenance dose. **Side Effects:** Many side effects may be transient. As the length of time the patient is exposed to the drug increases, most patients become more 'tolerant' and side effects become less severe.*** Profound sedation, ataxia (wobbliness), gastroenteritis, tremors, constipation and rashes (reported only in people). Polyphagia (increased appetite) and polydipsia (increased thirst) have been reported.

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- Felbamate

- Felbamate is an oral medication that is usually administered three times daily. Felbamate has a 4-8 hour half life. It is metabolized in the liver. Steady state blood levels may be evaluated within 10-14 days. Felbamate has proven to be very safe and toxic side effects are rare. Blood levels are typically not checked unless toxicity is suspected. Felbamate dosing typically begins at an initial, lower dose, and is increased every 2 weeks until adequate control is achieved or the maximum recommended dose is reached. Felbamate acts by blocking NMDA neural excitation, potentiating GABA mediated neural inhibition, and inhibiting activation of sodium and calcium channels. It may also help protect neurons from damage from hypoxia (decreased oxygenation) and ischemia (decreased blood flow), events that may occur subsequent to a seizure. This may be a significant benefit for the long term management of the epileptic.

Side Effects: One of the benefits of treating with Felbamate is that it has a very infrequent occurrence of side effects. Patients are usually not sedated and increased appetite and thirst is not reported. Bone marrow suppression and thrombocytopenia (very rare). Hepatotoxicity (liver toxicity) has been reported, but is rare and

often related to the use of Phenobarbital in conjunction with the drug.

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○ Clorazepate

- Clorazepate is a benzodiazepine derivative (a relative of valium or diazepam). It is given orally every 12 to 8 hours. It acts by enhancing gamma amino butyric acid (GABA) activity (an inhibitory neurotransmitter) in the brain. It is hydrolyzed in the stomach and broken down to nordiazepam. The half life of nordiazepam is variable and may be as short as 3 hours or as long as 6 hours. The variability can make initial dosing and achieving consistent therapeutic blood levels challenging. Nordiazepam blood levels may be checked to monitor for therapeutic blood levels. Peak and trough values (just prior to dosing and approximately 5 hours post dosing).

Side Effects: Sedation, drug tolerance, increased serum Phenobarbital concentrations, decreased serum nordiazepam concentrations with concomitant Phenobarbital dosing.

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○ Diazepam

- Diazepam is a member of the family of drugs called benzodiazepines. It is suspected that diazepam's mechanism of action is the facilitation of GABA activity, antagonism of serotonin and diminished utilization of acetylcholine. It may also have a direct affect of benzodiazepine receptors within the CNS. Diazepam (Valium) is not typically used for chronic seizure management. It is more useful as a medication given to stop active seizures. Since dogs and cats can develop a tolerance to its anti-seizure affects very rapidly, it is best that this drug be used sparingly. Diazepam is typically administered as an IV injection at the time of a seizure and dosing may be repeated once more. The

injectable form of the drug may be dispensed to be given orally or rectally to aide in control of seizures outside of the hospital. Sometimes a constant rate infusion (CRI) of diazepam may be recommended, if a patient is presented for recurrent seizures. CRI's of diazepam may last 24-48 hours, depending on the patient's response to the medication.

Side effects: Sedation is one of the major side effects of diazepam therapy. Behavioral changes such as hyperexcitability, depression, and irritability may be observed.

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○ Gabapentin

- Gabapentin is an oral medication that is administered every 8 to every 6 hours; it has a short half life and is partially metabolized through the liver. Its half life is 3-4 hours. It acts by enhancing the release and action of GABA and inhibiting neural sodium channels. Therapeutic blood levels can be checked, but this medication (like Felbamate) has a large margin of safety and typically blood levels are not monitored. Dosing is initiated then gradually increased until reaching the maximum recommended dose or therapeutic affect, which ever comes first.

Side effects: Side effects are seldom reported. Limited clinical evidence is available regarding efficacy.

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○ Zonisamide

- Zonisamide is an oral medication that is given every 12 hours. It's mechanisms of action are thought to be the blockage of calcium and sodium channels, modulation of the metabolism of dopamine, increase GABA activity and assist in the scavenging of free radicals. It undergoes hepatic metabolism. The dose is increased when the drug is added on to a protocol that includes Phenobarbital.

Side effects: Side effects are usually mild and may include sedation, ataxia and vomiting. These side effects are usually transient.

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- Levetiracetam

- Levetiracetam is an oral medication given every 8 hours. It's mechanism of action is unknown. The drug has a short half life of 3-4 hours. It is excreted through the urine and has no known hepatic metabolism. Drug levels can be monitored, but due to the drug's large margin of safety, routine monitoring is not usually required.

Side effects: Include vomiting, stiff, stilted gait, salivation. Typically these side effects are witnessed in patients receiving high doses of the drug.

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- **Minimizing cluster seizure activity/Status Epilepticus**

- One of the best techniques to minimize cluster activity and status epilepticus is to treat the underlying condition promptly and to initiate appropriate anticonvulsant therapies promptly. By controlling the seizure disorder the chance of status epilepticus and clusters should be diminished. Another technique to minimize the frequency of clusters and status is to treat seizures, when they occur, promptly. This means that plans will be instituted for at home management of clusters and parameters will be set for when your pet should be presented for emergency veterinary care. Patients that have prolonged seizure activity (in our hospital we interpret this as 3-5 minutes of continual seizure activity at home) or patients that have two or more seizures within a 24 hour time span cannot be managed at home and should be immediately transported to the nearest veterinary facility.
- Dietary Management, Acupuncture

- **What are the Owners' Responsibilities?**

1. Give all medications as prescribed. Do not change dosages unless you have discussed the change with Dr. Hass.
2. Communicate promptly and accurately to The Epilepsy Clinic regarding your pets' condition. All of your observations are important. It is vital that you communicate any changes in your pet's condition.
3. Visit The Epilepsy Clinic at least every 6 months or more often if requested by Dr. Hass. Some rechecks and blood tests may be provided by your general veterinarian. However, if you choose to have every 6 month blood levels and recheck exams performed by another veterinarian, it will be their responsibility to interpret the results.

