

EPILEPSY: A ROUND-UP OF FACTS AND IDEAS

by Carole Fry Owen

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The Bagpiper, 1993 #4

"Epilepsy. You're never going to eliminate it," stated veterinary researcher/teacher, Dr. Roger M. Clemmons, with what sounded like absolute certainty.

Hopelessness is not Clemmons' message, though. He makes a strong case for pragmatic, positive action in Scottish Terrier, and all canine, breeding programs.

Associate professor of neurology at University of Florida's College of Veterinary Medicine, Dr. Clemmons is familiar to STCA members as one of the veterinarians who, in the 1970s, did the original research on Scottie Cramp at Washington State University.

"I still feel a lot for Scotties because of my work with Ken Meyers on Cramp," said Clemmons. There may not be a Scottie in Clemmons' backyard, but this self-acknowledged terrier man shares his Gainesville, Florida home with a Jack Russell Terrier, whose exploits against squirrels delight him.

Unlike Scottie Cramp, the inheritance of epilepsy is very complex," compared Clemmons. "It involves at least six gene pairs, and it takes three matches out of those six pairs", to produce epilepsy. This fact was news to me, as it may be to you. It's been acknowledged by veterinary researchers for about 10 years.

The paradox is that two normal parents might each carry only two matches of these six pertinent genes and, thus, not be epileptic themselves. However, the roulette wheel of breeding may spin matchups of three or more of those critical genes to one or more of their offspring. Result: epilepsy.

In plain language, said Clemmons: "You can breed two normal dogs and get all epileptics. Or you can breed two epileptics and get all normal dogs."

"A disease like Scottie Cramp, you can eliminate," pointed out Clemmons. "Cramp is a simple, one gene defect with recessive inheritance."

Clemmons was not judgmental about our breed's failure to work out Cramp. Comparing the two disorders, he stated simply, "We can't even get rid of Scottie Cramp."

However, epilepsy is a different story. Clemmons is realistic about its complexity.

"Epilepsy, we're going to have to live with. The problem with the term 'epilepsy' is that too many breeders look at it as only an inherited disorder."

British geneticist, Malcolm Willis, agrees. In his popular *Genetics of the Dog* (1989), Dr. Willis cautions that it is, "dangerous for breeders to immediately assume that they have a genetic problem on their hands. Only when other possible causes have been checked as far as possible and been eliminated should the breeder begin to consider idiopathic epilepsy." That is not a light statement for a geneticist and German Shepherd breeder, who also wrote the definitive book on the Shepherd breed. German Shepherds are affected by a high incidence of inherited epilepsy and Willis had done much of the pedigree documentation of the disorder.

Here's where definitions and diagnostics become important.

First, the term "idiopathic." Idiopathic means, "of unknown causes." Idiopathic epilepsy is what classically is defined as true epilepsy or inherited epilepsy. It's the diagnosis breeders would rather not hear.

The best description of epilepsy I've found comes from the 1991 textbook by Clemmons' colleague in neurology at the University of Florida, Dr. Cheryl Chrisman. Anyone looking for a

comprehensive, easy-to-understand overview of true epilepsy and acquired seizure disorders should read Chapter 8, Seizures," pp.177-205, in Dr. Chrisman's Problems in Small Animal Neurology.

Chrisman writes:

"Epilepsy can be defined as a disorder characterized by recurrent seizures with no active underlying disease process occurring in the brain. Epilepsy may be caused by an inherited biochemical defect or may be acquired because of some cerebral insult resulting in a focus of neurons with altered thresholds."

Speaking of threshold, "Every animal, including the human, has a so-called seizure threshold that is genetically determined," writes Dr. Alexander de Lahunta in the 1986 STCA Handbook. "When this is exceeded, an uncontrolled neuronal discharge occurs that may cause what we observe as a seizure. This threshold varies among individuals and presumably is exceptionally low in those with idiopathic epilepsy. Genetic factors are believed to determine the structural and metabolic basis of this threshold. The role of the environment in influencing this threshold is unknown."

What to do

What should the owner do in his dog seizures? "The first step, which may be the most difficult for the concerned owner is to leave the dog alone!" directs Dr. de Lahunta. "This dog will usually not injure itself except for occasionally biting its lips or tongue. The dog will not 'swallow its tongue'."

Many have never seen a seizure. A typical epileptic seizure might progress as Dr. Samuel Hodesson once described in Dog News:

"Observant owners will notice a change in behavior for a brief period during which their pet may become restless, look worried, seek attention or stare into space. Loss of consciousness follows and pupils of the eyes dilate."

"Excessive salivation and chewing movements, commonly called chewing fits, may follow. Legs stiffen and the dog falls on its side. Paddling or running movements may alternate with periods of rigid extension of the legs and arching of the back. The patient may urinate or defecate during or after the seizure."

"Most attacks last but a minute or two and the recovery period is usually short though it can persist for as much as a day. During this state the dog may appear confused or wander about and bump into objects in the room."

Veterinary Evaluation

If your dog has a seizure, where do you start when it's over?

With questions, and lots of them. If your dog has more than one seizure, the recommendation is that a veterinary evaluation should follow. Your veterinarian should ask you (and if he doesn't, be prepared to offer the answers to these questions)-

Questions from "The Diagnostic Approach to Seizures," Veterinary Medicine (July, 1993):

1. What does the pet look like when it is seizing?
2. What is the duration and frequency of the seizures?
3. Are there any localizing signs?
4. Has the pet ever had an illness resulting in a fever?
5. Has the pet been exposed to toxicants?
6. Has the pet sustained any type of trauma?
7. Is the pet's vaccination status current?
8. Has the pet recently been in a kennel or pound?
9. Has the pet shown any signs of illness?

10. Do any of the pet's littermates have problems?
11. What is the pet fed, and how often is it fed?
12. Does the pet roam?

Clemmons suggests keeping a calendar of seizure activity. He said, "I've known dogs who only seized when watching Lassie on TV, or in the kitchen before food." Dr. Clemmons assured me that the Lassie example was no joke. He explained that for a dog that seizes at mealtime the stimulus could even be the pattern of the floor under the dish. One gets the idea that seemingly insignificant things may trigger seizures. You should be watching to discover the triggers. For instance, a female in estrus or pregnancy may have more frequent or more severe seizures.

Diagnostic tools your veterinarian may use in addition to your personal history are: physical exam, blood tests (complete blood count and serum chemistry profile), urinalysis and neurological exam. If these initial tests don't give an answer, your veterinarian may recommend a second tier of tests. Such evaluations may include, cerebrospinal fluid analysis, skull and/or thoracic/abdominal radiographs, electroencephalography (EEG), computerized tomography (CT scan), and magnetic resonance imaging (MRI). These tests could require use of a specialized care facility.

Types of Seizures

To get academic, there are three types of seizures; generalized, partial and partial with secondary generalization. It is important to determine which type of seizure a dog has because the type can show: 1) whether the condition is "true" epilepsy (the inherited variety); or 1) whether the condition is the result of an active disease process affecting the brain, or the result of a past insult to the brain which has left localized neurologic damage.

Total, or bilateral involvement of the brain causes "generalized" seizures. They may be mild and cause no loss of consciousness, or they may be severe, causing total loss of consciousness. "Generalized seizures are most often associated with metabolic disturbances, toxicities, nutritional deficiencies, and true or inherited epilepsy," states the Chrisman text.

A partial seizure is one in which the seizure discharge is focal, meaning a localized part of the brain is involved. Partial seizures are not typical of true inherited epilepsy. Underline this in your own brain! Chrisman says: "Partial seizures are most commonly associated with a focus of brain damage caused by an infection, metabolic insult, traumatic insult, or neoplasia."

Partial seizures include many forms of behavior: unilateral muscle twitching of the face or limbs; bizarre, aggressive behavior; chewing, lip smacking, and excessive swallowing; running; confusion; "fly biting;" star gazing;" hallucinations; episodic tail chasing and self-mutilation; and some chronic episodic vomiting and diarrhea.

Then, to complicate matters, there is the partial seizure with secondary generalization. It can look very much like a generalized seizure. The partial phase may last only seconds, and the owner may miss seeing it. However, it is very important, especially for the breeder, to determine if the seizure is partial or partial with secondary generalization. Both are usually associated with non-inherited focal lesions of the brain rather than true epilepsy.

Helpful clues to identifying the seizures as partial or partial with generalization are asymmetric motor activities. If you can detect asymmetric movements, maybe as simple as turning the head and lifting a forelimb before collapse, severe contracting of one side of the face, a difference of tone or movement in the limbs on one side, or any of the previously listed partial seizures, the condition with which you are dealing probably is not true epilepsy, according to the Chrisman text. Compulsive circling to one side during recovery also might indicate focal, rather than general brain involvement.

Chrisman's book differentiates between seizure types;

"An acute onset of severe, frequent seizures could indicate an infectious, toxic, nutritional, metabolic or neoplastic process."

"An intermittent seizure disorder with no other neurologic abnormalities in between the seizures, which has been going on for a year or more, is most likely epilepsy."

Causes of Seizures

Rather than go into great detail about all the problems which can cause seizures, I point you to Dr. Chrisman's Differential Diagnosis table, (Problems in Small Animal Neurology, p. 83). It summarizes conditions common at different ages:

"Young (under 9 months of age)-- congenital hydrocephalus; lissencephaly; lysosomal storage disorders; distemper...and other causes of encephalitis; trauma; toxicity--lead, organophosphates, etc.; hypoglycemia; hepatic encephalopathy--portacaval shunt; other congenital defects with associated metabolic disorders; thiamine deficiency."

"Adult (9 months to 5 years)--distemper...and other causes of encephalitis; trauma; toxicity--organophosphates, etc.; hypoglycemia; hepatic encephalopathy--portacaval shunt, acquired cirrhosis; other acquired metabolic disorders; true epilepsy; acquired epilepsy; cerebral neoplasia--rare."

"Old (5 years and older)--distemper... and other causes of encephalitis; trauma; toxicity--organophosphates, etc.; hypoglycemia--insulinoma; hepatic encephalopathy--acquired cirrhosis; other acquired metabolic disorders; acquired epilepsy; cerebral neoplasia."

One point which might be made here is that hypoglycemia is the most common metabolic cause of seizures in small animals. The causes of hypoglycemia are myriad: severe infestations of parasites, stress, excessive insulin during treatment of diabetes mellitus, insulinomas (pancreatic tumors secreting excessive insulin), hypoadrenocorticism (Addison's Disease), hypopituitarism, chronic liver disease, acute pancreatitis, and sepsis.

Dr. Clemmons did state, however, that metabolic sources are not the most common cause of seizures. "If you look at all mechanisms behind seizures, infectious/inflammatory brain diseases are probably the most common cause of seizures," said Clemmons. He placed trauma and post trauma as the second most common cause of seizures. Metabolic problems, toxicity, and neoplasia (cancer) probably stand in third, fourth and fifth places, according to Dr. Clemmons. He does remind that a cause like cancer can move up in that order within specific breeds that have a higher incidence of cancer, or in old dogs that also are at greater risk for cancer.

"Probably 40% of seizures are idiopathic," said Clemmons. "That doesn't mean that they all are inherited, but that we can't say they aren't. The majority of seizures we see are acquired ones." He noted again that infection/inflammation, either current or past, are prime causes.

Numerous other conditions can cause seizures. Just one of these of special interest to Scottish Terrier breeders is the fact that hypothyroidism can be a precipitant of seizures. VWD researcher, Dr. Jean Dodds, has identified Scottish Terriers as a breed with a high incidence of hypothyroidism as well as von Willebrand's Disease.

Most frequent toxic causes of seizures are lead and organophosphate poisoning. Actually, said Dr. Clemmons, lead is a fairly rare cause of seizures these days because of decreased sources of lead contamination. Still, lead toxicity might be considered if a dog lives in an older home where lead-based paints were used. Dr. Chrisman's chart of chemicals that cause convulsions lists 128 substances, just a few of which are ethylene glycol (antifreeze), theobromines (chocolate), castor beans, narcissus bulbs, nicotine and gasoline.

Especially worrisome to breeders is the fact that idiopathic epilepsy can be the "easy" diagnosis if an incomplete work-up is done, or if the key "clue" has been missed. "Did we just not

find the cause?" is the question many dog owners end up asking themselves, hoping that's the answer instead of idiopathic epilepsy.

High Incidence Breeds

Inherited epilepsy does have a higher incidence in some breeds. It has been studied in Beagles, German Shepherds, Keeshonds, Tervuren Shepherds and Irish Setters. Miniature Poodles, Golden Retrievers, Siberian Huskies, Wire Fox Terriers, Cocker Spaniels and Saint Bernards also are suspected of having inherited epilepsy (Chrisman text). Veterinary Medicine's July, 1993, issue adds Alaskan Malamutes, Collies, Dachshunds, Labrador Retrievers, Lhasa Apsos, Mastiffs, Miniature Schnauzers, Standard Poodles and English and Welsh Springer Spaniels as breeds with a high incidence of primary epilepsy. Boxers and Shetland Sheepdogs also are listed among affected breeds in Willis' Genetics of the Dog.

In addition to the above breeds, Veterinary Medicine (July, 1993) records breed dispositions to seizures caused by inherited or congenital disorders which include many of the above breeds as well as Chihuahuas, Boston Terriers, Maltese, Yorkshire Terriers, Chow Chows, Pomeranians, Toy Poodles, Shih Tzu, Irish Wolfhounds, Border Collies, Basset Hounds, English Setters and German Short-haired Pointers. Still no Scotties listed.

Interestingly, male dogs are affected with true inherited epilepsy to a greater degree than females. The Merck Veterinary Manual's 1986 edition quotes the incidence of epilepsy in Beagles as 11.9% in males and 2.6% in females, and suggests involvement of a sex-linked suppressor gene. Other studies corroborate these figures. Willis' book mentions a 1975 Keeshond study which showed seizures about 4 times as prevalent in males as in females; a 4.6 to 1 male-to-female ratio among Beagles with clinical symptoms of epilepsy in a 1971 study; and a 3.6 to 1 ratio weighted toward males in a 1974 British study of German Shepherds.

General frequency of epilepsy? Chrisman's text states:

"Acquired Epilepsy: Incidence, Frequent."

"True Epilepsy: Incidence, Frequent in Certain Breeds."

Scottish Terriers are listed by neither Chrisman, nor in any of the other literature I examined, as one of the breeds with a high frequency of epilepsy!

Dr. Clemmons seconds that; "Seizures aren't a big problem in Scotties. My gut reaction about Scotties is that incidence is probably 1% or less, certainly not like in other breeds where epilepsy is commonly documented." However, Clemmons adds that there is no breed of dog or even non-purebred group of dogs that is free of seizures.

The overall incidence of epilepsy in dogs is, in fact, about 1%, according to Clemmons. He put the incidence in Beagles at 5.9%, one reason being Beagles' former use in highly inbred laboratory colonies.

Control of Seizures

For those who do have dogs with epilepsy, control is the interest.

Relatively normal lives are possible for most seizure-affected dogs, if medicated with appropriate anticonvulsants. Stephen Ettinger's Textbook of Veterinary Internal Medicine (1989) quotes one study which shows seizure control achieved in about 60% of affected dogs when phenobarbital is used. Ettinger defines seizure control as a 50% decrease in seizure frequency without drug intoxication.

Phenobarbital is the drug of choice for seizures. "Always use it first," asserted Clemmons. Ettinger goes so far as to claim, "Phenobarbital is the only anticonvulsant with proven efficacy in controlling seizures in dogs."

Primidone (Mylepsin or Mysoline) and diphenylhydantoin (Dilantin) are also drugs mentioned in seizure control. There are other less commonly used pharmaceuticals which may be tried in hard-to-control cases. Clemmons rarely uses primidone because of its potential for liver toxicity. Also, though diphenylhydantoin still is listed among veterinary anticonvulsants, Clemmons said it is probably an ineffective drug in dogs, even in combination with other medications.

Liver toxicity is, in fact, the most common problem of long-term anticonvulsant medication. With Scottish Terriers at greater risk of liver problems than many breeds, this fact can make control of seizures in some Scotties a challenge. Clemmons tempered that by saying, "Toxicity from anticonvulsants is somewhat independent of usual causes of liver disease. Even if a dog has liver disease, it still may do well on anticonvulsants, with modified dosages."

Unfortunately, "all long-term anticonvulsant therapy has some negative effect on liver function, but phenobarbital may have the least effect" (Chrisman text). Serum drug levels should be monitored at least every six months after steady state and seizure control have been achieved," directs Ettinger.

Fortunately, treatment with phenobarbital is not expensive. Chrisman lists a 1990 sample cost of phenobarbital therapy for a 14 kg (30 pounds) as 14 cents a day for a starting dose.

When should drug therapy be started?

Ettinger suggests: "As a rule, anticonvulsants should be considered when single seizures are occurring more than once every six weeks or clusters of seizures are occurring more than once every eight weeks." This is not a hard and fast rule, according to Clemmons: "Single severe seizures of clusters must be treated. You have to look at the severity."

A different angle is given in Veterinary Medicine's "Symposium on Seizure Disorders" (July, 1993): "There is convincing experimental evidence that repetitive seizures may irreversibly lower the seizure threshold in some patients, a phenomenon referred to as kindling...Therefore, early aggressive anticonvulsant therapy might result in better long-term seizure control." However, amplified Clemmons, it is important to get enough frequency of seizures to know if medication is effecting a change. When medication is started, said Clemmons, "I don't like to play catchup." He suggests beginning with high dosages and working down to minimum levels which will control seizing.

New Drug Therapy

An interesting new therapy which Clemmons pointed out is use of potassium bromide in conjunction with phenobarbital. This treatment is not described in all vet texts. I checked Ettinger's, the Bible of many veterinarians. Potassium bromide therapy is not mentioned in its chapter, "Seizures". Your own veterinarian may be unaware of the advantages of potassium bromide. Chrisman's text discusses it extensively.

Phenobarbital/potassium bromide is a combination especially helpful in dogs with severe cluster seizures not controlled well with phenobarbital alone, according to Clemmons. He also indicates its value in dogs having liver problems which preclude receiving the necessary control levels of phenobarbital. "With potassium bromide, you can usually reduce phenobarbital to 1/8 the normal dose," said Clemmons.

One investigator Veterinary Medicine quotes (July 1993) even estimates that 50% of epileptic dogs can be managed with bromide alone. The same report declares that bromide is the most satisfactory secondary anticonvulsant. It estimates that about half the dogs that continue to have seizures on what should be adequate phenobarbital dosages will benefit from addition of bromide.

Potassium bromide has been in use with human epileptics since 1857. For dogs, its use is more recent. The special value of potassium bromide lies in the fact that it does not induce production of liver enzymes and does not interact with drugs which the liver metabolizes (e.g. phenobarbital). Veterinary Medicine calls bromide the anticonvulsant of choice for dogs with liver disease (July, 1993).

The down side of potassium bromide therapy is that it may not be easily available to your dog. This chemical is not approved for use in dogs, and an investigational drug license is needed to legally dispense it. There can be human toxicity with excessive handling of the raw chemical. Not commercially available, potassium bromide must be purchased from chemical supply houses as an American Chemical Society chemical grade reagent (addresses of five chemical supply houses which carry it listed in Chrisman text). To try potassium bromide therapy, you may need to work with your nearest veterinary medicine teaching facility. However, it would be worth checking to see if your own veterinarian might obtain the investigational drug license necessary to dispense potassium bromide.*

The simplest course of action, according to Clemmons, is for a local veterinarian to locate a pharmacy within his state which has the investigational license to formulate and compound chemicals like potassium bromide. The veterinarian then can prescribe potassium bromide from that particular pharmacy, even though he himself doesn't have an investigational license. Dispensing can be done by mail-order if necessary. Chrisman's text lists the following information about potassium bromide therapy:

Suggested dosage is 25 mg/kg (effective serum level, 500 - 1,000 microgram/ml.). If used with phenobarbital, give orally once daily. If used alone, give twice daily. Sedation is noted as a side effect (no other side effects listed). Cost (1990) for 14 kg dog (30 pounds): \$.07/day.

Dr. Clemmons commented that potassium bromide can be dosed at a higher level, but that Chrisman's suggested dosage is the usual starting level. He emphasized that if a dog is already on anticonvulsant when potassium bromide therapy is started, the anticonvulsant should be cut by half after the second dose of potassium bromide to avoid excessive sedation. Clemmons said that quantitative blood levels should be done after the first month on potassium bromide and then every six months for dosage adjustment.

*(To apply for an investigational license, contact Marcia K. Larkins, DVM, Chief of Companion and Wildlife Drugs Branch, HFV-112, Center for Veterinary Medicine, Food and Drug Administration, Rockville, MD 20857.)

Other Ideas for Control

Besides medication, special recommendations Clemmons makes for dogs with seizures are:

1. Balance maintenance diet, low in protein.

2. Heartworm preventative - Use diethylcarbamazine (DEC) products (like Filarbits®) rather than once-a-month preventative.

Clemmons suggests avoidance of Filarbits Plus®. Chrisman text says Ivermectin should not be used.

3. Avoid organophosphates for flea/tick control. Instead, use pyrethrin products, carbamates or products with Precor® insect growth inhibitor. He mentions Vet-Kem's Ovitrol Plus® as a good pyrethrin/Precor® product.

4. Avoid drugs known to interact to lower seizure thresholds. A number of drugs can either increase or decrease anticonvulsant concentration. (Chrisman's text lists drugs to avoid if a dog is on anticonvulsant therapy: digitoxin, dipyrone, griseofulvin, phenylbutazone, chloramphenicol, amphetamine and phenothiazine tranquilizers. A common tranquilizer which should be avoided is acepromizine.)

Read, Read, Read

What I've touched on in this article is only the skimmings off the top of the subject of epilepsy. When asked to write, I had only superficial information on epilepsy. I've learned more than I bargained for. My printed sources are listed at the end of the article. They have been forwarded to Gail Gains, STCA Health Committee Chairman, for the Club's reference library. Many of these articles, like Chrisman's text, have extensive bibliographies of their own, from which interested members may dig even deeper. Members desiring to share additional information about epilepsy may contact me (Carole Owen, 9 Coachman's Circle, Big Spring, TX 79720; phone 915/263-3404). If interest warrants, I will be happy to put together a follow-up piece.

To tell you how much I've learned myself about epilepsy, I have to share a personal anecdote. "I've never seen a seizure," I blithely told the first couple of STCA members I interviewed. Well, a few articles of reading later, I discovered that I've probably been living with a seizure disorder for nine years and didn't know it.

The first dog on which we finished a championship has had a bizarre form of recurrent behavior which has never worried me. I haven't even mentioned it to a vet. It seems that minor. Every few months, for many 15 or 30 seconds, Cubby chases her tail or hind leg in a tight circle in one direction, like she's trying to bite a flea off her rear end. However, there are no fleas!

This is an asymmetric motor activity described earlier as one type of partial seizure. Since partial seizures usually are acquired disorders and are not primary epilepsy, I looked for a possible explanation. I remember her breeder telling me Cubby was the only puppy in her litter to survive a raging staph infection. Perhaps the early infection and fever carries the answer?

I am sure many STCA members have learned about seizures on their own, too. An important part of any discussion of seizure disorders in the Scottish Terrier must be input from our breeders.

"You're walking in a minefield. This is an explosive subject," I was warned when I started asking breeders for feedback on epilepsy.

In an attempt to handle the subject with great delicacy, I assured breeders of confidentiality. They shall be identified here only as "Breeder A", "Breeder B", etc., and will be referred to by the generic "he" - even the "she's". Nor will I "point a finger" at any individual dog or line suspected of producing seizures.

Secrecy, A Problem

Breeder A: "Most breeders don't talk about epilepsy. I don't know that we have a true picture. Epilepsy and Scottie Cramp are the two things people don't talk about. People only tell you what they want to. They don't tell you the rest."

Breeder A related a personal experience with a young bitch that started seizing several points away from her championship: "I was devastated. I'd never had any of that before."

Tests at a well-known veterinary center did not identify a cause for the seizures.

"The veterinarian said, 'You don't have any of that behind you. You can breed her.' I knew better. I didn't."

The bitch was spayed and placed as a pet. When her new owner eventually stopped medication, the bitch had no more seizures. "I often wondered if this was a hormonal situation," pondered Breeder A. "There was no problem with seizures after spaying. If she was a true epileptic, she should have seized the rest of her life."

Breeder A emphasized his belief that split shot/killed vaccine immunizations can be important in avoiding some seizures.

Early Onset Seizures

Breeder B told of severe, early onset seizures. A pet he had sold seized at 7 1/2 months of age. Its seizures came in severe clusters of five or six seizures in one day. Several days later, the seizures would repeat. At final count, the puppy had almost 40 grand mal seizures in a month. Chasing another dog a few weeks after seizure started, this puppy broke its leg. The veterinarian predicted the leg would not stay set during future seizures. He put the puppy down.

Because of age at onset and severity of seizures, this puppy likely was not a case of idiopathic, inherited epilepsy, according to its veterinarian. Breeder B emphasizes that a diagnosis was lacking, however. There was no autopsy, nor any final determination of cause. Breeder B had no previous seizures in his own dogs, but set about checking dogs and families of dogs behind his for possible existence of seizure disorders.

A Tragic Dog Fight

Breeder C describes his own tragedy with seizures, the loss of a beloved homebred champion. Seizures started about 1 1/2 months after a monumental attack on this Scottie stud by a male of one of the large terrier breeds. Breeder C calls the fight "horrible" with both dogs covered in blood/mud/saliva. The Scottie suffered a deep gash below his ear and bad punctures on top of his skull.

This Scot died about two months after its first seizure. Breeder C described one of the dog's final seizures as a terrible hour-and-15-minute affair. After that seizure, the dog showed no comprehension of the breeder and exhibited bizarre behavior, "He started 'tasting' - tasting carpet, tasting me, my clothes, the bedspread. When he got to the bottom of his dish of food, he just kept licking. He was mentally gone. Soon he lost bowel and bladder control and went in circles."

Breeder C does not worry about these seizures being hereditary. Veterinary diagnosis: seizures caused by trauma to the head suffered during the dog fight.

Allergy/Immune Problem

Breeder D has groomed many pet Scotties. He told of several with seizure problems, which, if dewormed, would cease having seizures - until they contracted tapeworms again.

"Maybe the breed doesn't have a problem with true epilepsy." speculated Breeder D. "Maybe many seizures are the result of reactions to other primary problems - like allergies or immune problems."

Breeder E: "There are many, many forms of epilepsy. All of us love our dogs. If you've been breeding for a long time and it doesn't show up until late in a dog that you've used extensively, what do you do?" He left his comments as a question.

Oxygen Deficit?

Breeder F: "We lucked out...had only one epileptic, from a complete outcross. I'll never forget it. I walked out with a bucket of food, and she keeled right over. She was about 9 months old. We did all kinds of blood work. She started seizing routinely under stress. (An old terrier man) looked at her and said it was definitely epilepsy. We tried various medications. Nothing would work. She would be fine. Then, with a loud noise, she'd go down. We had her spayed. Finally, she was down more than up." The bitch was euthanized at three years old.

Was hypoxia the cause of this bitch's seizures? Breeder F later remembered that, at birth, one bitch in that litter couldn't get going right away and was probably oxygen-deprived. None of the litter mates developed seizures.

Four-Hour Seizures

Breeder G: "One of our main dogs had seizures forever, and we eventually lost him. The dog was used at stud early in life before we knew he had these problems. He was a very proud dog. It was terrible."

Seizures started as 2-minute episodes when this dog was two years old. "First, it was once every 6 months, then every month, then every two weeks, and by 8 years old, every day." Breeder G described the terror of the 4-hour seizure. Ice packs were kept in the freezer for packing this dog during long seizures.

The dog finally died of liver failure. "Phenobarbital does the liver in," said Breeder G, "and Scotties' livers are iffy."

Breeder G mentioned that the dog had received combination shots as a puppy: "I had a feeling that in pups given combo shots, bang-bang-bang, something happens. I now stretch out shots forever, and give killed parvo and killed vaccines whenever possible."

After living with seizures, Breeder G feeds what he terms "environmentally correct food" and never uses flea/tick sprays or dips. He did suggest that seizures may be familial in nature.

"Epilepsy is no fun," asserted Breeder G. "I wouldn't wish it on anybody, but I guess it's all around us. At a Scottie party, I heard new owners (pet people) talking about their dogs having epilepsy."

Breeder H thinks Scottish Terrier breeders should worry about acquired seizures, too.

He said, "If our breed has certain tendencies toward conditions which can produce seizures, we need to take the seizures as a point-blank warning to breed away from those conditions. Sure, a breeder may truthfully claim he hasn't had idiopathic, inherited epilepsy. But perhaps his dogs have had seizures that are inherited second-hand, as step-children of other problems to which the Scottie is predisposed. We need to accept seizures as a red flag to deal with dirty laundry."

A Wake-Up Call

Breeder I: "The problem with epilepsy is it's hard to distinguish idiopathic, inherited epilepsy from seizures brought on by a specific cause. Unfortunately, people always want to give themselves the benefit of the doubt. When a breeder has a dog with seizures, he is inclined to blame anything but inheritance. Because of the seriousness of the problem, he should assume the worst."

"A time bomb," Breeder I calls the problem of seizures in Scottish Terriers. "I have a file of pedigrees of dogs that have seizures." Flipping through the file, Breeder I said, he sees definite tendencies.

Distilling Breeder I's evaluation of those files into one simple sentence of my own wording: "If a popular stud dog produces a condition like seizures, the problem eventually will compound itself."

"There is no doubt that some forms of epilepsy are inherited," said Breeder I. He, himself, has had a few dogs with seizures. Unlike many other breeders with whom I talked, he not once tried to assign the blame of those seizures to any acquired cause.

"We feel like we have to be ruthless," Breeder I said of elimination of any problem dog from a breeding program. "It's easier for breeders who haven't painted themselves into a corner," he continued about the values of diversity versus extremely tight breeding.

"One idea that would help is an open health registry. People who don't have the problem (yet) would cooperate. Once you do it (share information), you find out it's not that hard."

"It's definitely time for a wake-up call for our breed," warned Breeder I. "Epilepsy is not something we can live with. You can't deal with seizures in pet puppies. A dog with seizures: you're selling a major heartache and a major headache. If Scottish Terriers get a reputation for epilepsy, our pet puppies will be hard to sell."

Diversity, But Accord

There is certainly no lack of diversity in type and cause of seizures in Scottish Terriers, nor in our breeders' opinions as to whether the seizure disorders in their own dogs are inherited. I wish space permitted even more breeder interviews.

What no one claims is that seizure disorders can be taken lightly. There is unanimous accord there! From that consensus, perhaps Scottish Terrier breeders can move forward to work together. I discovered in my interviews that there is already a certain degree of openness about the subject of seizure disorders. Why not take the first step and discuss seizures yourself with other breeders? Especially if you are willing to share your own experiences, you will often find someone willing to share right back.

Inheritance Studies

What might you get if you were to breed two dogs that have idiopathic epilepsy? Clemmons stated earlier: Maybe 100% normal dogs.

However, an interesting case study in *Veterinary Medicine* (November, 1991) reports a litter produced by the accidental mating of two related Labrador Retrievers which each had idiopathic epilepsy. The puppies started having seizures at an unusually early age. Dr. Valrie Gerard and Dr. Cliff Conarck explained that the onset of seizures in dogs with idiopathic epilepsy usually occurs between one and three years of age, but rarely before six months of age.

In this particular litter, three puppies of the 10 started seizing between 54 and 63 days of age. Two others began seizing at 18 and 20 months old. With two puppies having died of unrelated causes by the time the study was written, five of eight surviving litter mates (63%) were affected by seizures. The authors report similarly high percentages of epileptic offspring (30% to 100%) in other litters from two epileptic parents. Of particular interest was the authors' recommendation: "The occurrence of seizures in unusually young puppies warrants checking the family tree for the presence of idiopathic epilepsy."

Clemmons pointed out that the Gerard/Conarck study and recommendations are based on a small amount of data. He reiterated that in young dogs infection, metabolic disease and trauma are the primary causes of seizures; and that true inherited epilepsy usually doesn't appear until puberty or perhaps two years of age or later.

Another article tracing the incidence of epilepsy through four generations of test-bred epileptic dogs is, "Inheritance and Idiopathic Canine Epilepsy", by Dr. James Cunningham and Dr. George Farnback (*Journal of the American Animal Hospital Association*, July/August, 1988).

Cunningham's and Farnback's conclusions: "Genetic mechanisms play an important role in transmission of some and possibly most cases of idiopathic canine epilepsy, although the

mechanism for this inheritance is not yet known. Until the genetic mechanisms involved are more clearly delineated, the authors recommend that veterinarians advise owners of dogs with idiopathic epilepsy that:

- 1) the idiopathic form of canine epilepsy may have a major genetic component;
- 2) it generally is impossible without considerably more test breedings to determine the degree of involvement of either dam or sire in producing epileptic offspring;
- 3) it is unwise to breed an epileptic dog or repeat the breeding that produced it and it is unwise also to breed its litter mates."

Norwich Terriers are a breed, like our own Scottish Terriers, which has not been mentioned yet in any of the veterinary literature I examined as having a high incidence of epilepsy. Norwich breeders are getting concerned, though. Wrote breeder Knowlton Reynders in "Epilepsy in Norwich" (Dog News, January, 1992):

"I feel very strongly that we have it, visibly and less visibly, in many lines of our breeding - old and new. In fact, no one can say with certainty that one is entirely clear of the problem. The evidence strongly suggests that idiopathic seizures are transferred genetically. And the solution is diligently to breed away from any animal with a history or lineage containing suspicious seizures." Make Intelligent Choices

"The problem with epilepsy: this is not simple Mendelian genetics. You cannot breed it out," repeated Dr. Clemmons. "All you can do is make intelligent choices. If you breed two dogs and you get seizures, don't do it again."

"Maybe, looking back, you might discover that when you get epilepsy is with long-nosed Scotties," hypothesized Clemmons.

Far-fetched idea. I thought to myself. However, what did I run across in research? The chart, "Differential Diagnosis of Seizures in Dogs and Cats," in Veterinary Medicine (July, 1993) lists seizures due to primary brain tumors (meningiomas) as predispositions of dolichocephalic dog breeds.

What is that "d" word? I checked the dictionary: "Dolichocephalic: long-headed; having a breadth of head small in proportion to the length from front to back." Isn't that the Scottish Terrier? True, seizures due to primary brain tumors like meningiomas would certainly be an acquired seizure disorder. However, who can say what future research will turn up as far as special breed characteristics that might come associated with primary epilepsy? It might not be long noses, but Clemmons did point out eventually we could discover that certain visible traits are linked with epilepsy.

A practical problem hindering learning more about epilepsy is research funds. "One time, dogs were a model of human epilepsy," said neurologist Clemmons. "Since they aren't any more, funding is less."

One program active in the study of epilepsy is the American Canine Epilepsy Service. Directed by Dr. Betsy Dayrell-Hart, V.H.U.P., School of Veterinary Medicine, University of Pennsylvania, 3850 Spruce Street, Philadelphia, PA, 19104. The service offers advice on treatment and gathers data on the disease. You may wish to contact the service.

Good Advice: Share Information

"Epilepsy is so complicated," asserted Clemmons still again. "The only thing you can do is pass information that, 'That wasn't a good match!'"

Clemmons reminds Scottish Terrier breeders that, until there is gene mapping, we can't say with absolute certainty that a case is inherited. We can only guess. Here's where Clemmons thinks an open registry might help. "If you're a breeder, and you're getting a problem you want to find

out where it is. Make reasonable choices and pass information back and forth between breeders. We should be saying things to each other like: 'You're doing a lot better than me. What are you doing better?'"

The perspective Clemmons puts on epilepsy for individual Scottish Terrier breeders is: "If you're getting more epilepsy than Beagles (5.9%), you're not doing as well as the Beagles can do on their own." Clemmons likes the comment he once heard from a knowledgeable person in one of the national hound clubs: "In all honesty, all you can do is make your best guess. If you make a wrong guess, try to make a better guess next time."

A final personal note I might put on the subject: Scottish Terriers are not yet in the textbook lists of those breeds highly affected by seizure disorders. Will it stay that way?

Currently, Scottie Cramp and sensory neuronopathy are the only two disorders listed under the Scottish Terrier breed in Chrisman's comprehensive neurology textbook. I'm betting a veterinary text from 40 to 50 years ago would not have listed Scottie Cramp. We did not deal with that disorder. We are in the textbooks now. Will we deal with seizure disorders.

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