SCOTTISH TERRIER CLUB OF AMERICA

Scottie Cramp: A Review of Cause, Characteristics, Diagnosis and Treatment

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The Scottish Terrier breed of dogs is affected by an inherited neurological disorder characterized by transient episodes of muscular hypertonicity. These episodes result in postural abnormalities and locomotor difficulties that can be induced by excitement or exercise. The condition was first described in Scottish Terriers by Klavenbeck et al.,1 in 1942, and has come to be commonly known as ÍScotch or Scottie Cramp.Î This article will review past developments and present recent findings in Scottie Cramp that are of clinical interest.

Clinical Signs of Scottie Cramp

Meyers et al.[2] described the clinical presentation of dogs afflicted with Scottie Cramp, the criteria useful in diagnosis of the condition, and tentative therapeutic measures for the disorder. Physical activity or the psychic responses of excitement or fear are effective in precipitating an episode, while anxiety inhibits the manifestation of clinical signs. The dogs appear normal at rest and exhibit normal locomotor activity upon initial exercise.

However, with continued excited exercise, clinical signs may be seen. The onset of signs is preceded in some dogs by a slight abduction and winging of the forelimbs, while in others the initial sign is an arching of the lumbar spine or an overflexing of the rear legs while walking. From this point, there is an increasing resistance to movement and increasing tonus in the extensor and flexor muscle groups so that the animal

exhibits a goose-stepping gait. Extensor rigidity in the rear legs becomes progressively more pronounced. If the dog is running, the extensor rigidity in the rear legs may cause the animal to somersault and fall. In the most severely affected dogs, locomotor activity becomes increasingly hindered and occasionally, the animal will run in place. The head becomes extended with the nose pointing toward the ground. If the exciting stimulus is continued, a pillar-like stance becomes evident and locomotor activity is impossible. At this time, the dog may curl into a ball, respiration may appear to cease momentarily and facial musculature may show signs of involvement. Once the stimulus is removed, the clinical signs progressively decrease until they are no longer observed.

The severity of the clinical signs and time required to elicit signs vary from dog to dog The authors have observed dogs that exhibit only mild clinical signs and, then, only under extreme circumstances. On the other hand, some dogs are nearly incapacitated after short periods of exercise. There are several possible reasons for the variation, the most prominent being environment, nutrition, psychological factors and genetic differences.

Meyers et al.[3] presented evidence showing that the defect appears to reside in the central nervous system (CNS) - in those neuronal systems that control or moderate muscle activity. In Scottie Cramp dogs, the neuronal signal is hyperactive and the resultant muscle contraction is more intense and prolonged. Therefore, the prominent clinical signs, such as an arching of the back, goose-step gait and sudden catapulting of the rear quarters while running, are observed. Since the clinical signs are due to alteration in control of normal muscle contraction, Scottie Cramp is not analogous to a muscle cramp and pain is apparently not part of the episode. The name Scottie Cramp describes the clinical signs and not the pathology of the disease.

The defect appears centered in motor systems. There is no detectable alteration in intelligence and spirit. The animalÌs health is not affected by the disease, the life span of the dog is not shortened, and an increased incidence of postnatal mortality (with evidence of affected offspring in the litter) has not been reported. Clinical laboratory findings are normal.

Pathological examination of dogs with Scottie Cramp failed to reveal any abnormalities. In these studies, special emphasis was placed on the muscle and the CNS. The absence of gross and histopathological lesions in the Scottie Cramp dog indicates a functional rather than a structural abnormality. The clinical sign of Scottie Cramp, normalcy at rest and latency before signs become apparent, coupled with the absence of observable pathological findings, suggest the possibility that the clinical signs might result from a progressive depletion or accumulation of a compound within the CNS.

Genetic Basis of Scottie Cramp

Based on pedigree analysis, a genetic basis, with a recessive mode of transmission, has been suggested for Scottie Cramp[4] A genetic basis is supported by the fact that only the Scottish Terrier breed has been shown to exhibit the disorder. Furthermore, successive matings of affected males to affected females at Washington State University have resulted in more than 30 offspring, all affected with Scottie Cramp. Outcross mating to nonaffected dogs produced only normal offspring. These facts provide additional support for a recessive trait. Not all dogs are affected to the same extent. This is apparently due to the transmission of other genetic information which may influence or modify the expression of a defective gene. This difference in genetic makeup is one reason why some Scottish Terriers with scottie Cramp rarely exhibit clinical signs while others are nearly incapacitated.

Scottie Cramp can be observed in puppies as young as 6 to 8 weeks, providing they are heavily exercised while excited. If the puppy is normal in maturation, the clinical signs are usually seen within 5 minutes. As this is a genetic disease, a dog will have Scottie Cramp for its entire life and the condition can be treated but

cannot be cured. The condition will not increase in severity unless other factors in the dogs environment or its health status are altered.

It is possible to selectively breed Scottie Cramp out of a line of Scottish Terriers. This requires considerable time, effort, and a means of identifying affected dogs. By maintaining good breeding records, testing every offspring for Scottie Cramp prior to selling, and mating only nonaffected dogs, it is possible to significantly reduce the incidence of Scottie Cramp.a In the process of selective breeding, it is important not to sacrifice characteristics for which the line is noted. The authors have been working closely with a breeder and have markedly reduced the incidence of Scottie Cramp while strengthening the overall conformation of the dogs.

The Role of Serotonergic Neurons in the Modulation of Scottie Cramp Behavior
Meyers et al.5 examined the possibility that the clinical signs resulted from an anomaly within a neurotransmitter system in the CNS and found that the clinical signs of Scottie Cramp are closely related to the functional status of serotonergic neurons. These neurons are so named because they release a compound called serotonin as their neurotransmitter substance.[5-7] The functional potential of these neurons can be assessed by monitoring the cerebrospinal fluid (CSF) concentration of both 5-hydroxyindoleacetic acid (5HIAA), the major metabolite of serotonin, and tryptophan, serotoniǹs precursor amino acid. These compounds are subject to circadian variation, and the severity of clinical signs correlates with these daily changes.[6] When the CSF levels of these compounds are at their lowest, clinical signs are most severe. The converse is also true. Thus, clinical signs are most prominent at the end of the daily light cycle and less prevalent at night or early morning. This and other findings lead to the suggestion that serotonergic neuronal function modulates the expressions of Scottie Cramp behavior.

Pharmacological agents altering the capacity of serotonergic neurons to respond influence the clinical signs of Scottie Cramp.[5-7] Treatments that increased the CNS levels of serotonin provided a beneficial effect. Nialamide, a relatively selective monoamine oxidase inhibitor, improved the clinical rating by preventing the catabolism of serotonin. Peters and Meyers6 examined the functional consequences of exogenously administered tryptophan. Intravenous administration of this serotonergic precursor provided substantial improvement in Scottie Cramp behavior, even at the lowest treatment dosage (30 mg/kg). The CSF 5HIAA levels closely followed the improvement in clinical signs.

Treatments decreasing serotonin levels in the CNS markedly increased the severity of the clinical signs. Para-chlorophenylalanine (p-CPA), a noncompetitive inhibitor of tryptophan hydroxylase (the first enzyme necessary for the formation of serotonin), markedly increases the clinical signs.5 The specificity of this effect is evident in that 5-hydroxytryptophan administration, which restored the depleted serotonin, could reverse the p-CPA-induced increase in clinical signs. Methysergide, a selective serotonergic receptor blocker, increases the clinical signs of Scottie Cramp in a dose-dependent manner.c

Meyers and Schaub[7] undertook further investigations into the mechanisms by which serotonergic neurons modify cramp behavior. Concentrations of regional brain serotonin, whole blood serotonin, CSF 5HIAA, and urinary 5HIAA were normal in affected dogs at rest. Recently, Peters and Meyers8 have shown that the turnover of serotonin in the CNS is decreased following an episode of cramp behavior. Thus, while serotonergic neuronal function is normal at rest, there is a functional deficiency during excited exercise which presumably allows the expression of clinical signs.

Recent investigations into the nature of serotonergic neuronal modulation of Scottie Cramp behavior have shown that the formation of prostaglandins within the CNS is essential in providing a beneficial effect from serotonin. Compounds that inhibit prostaglandin synthesis increase the severity of clinical signs and, thus, act similarly to those treatments that reduce serotonin function. Aspirin, indomethacin, phenylbutazone, and penicillin derivatives are examples of compounds of clinical importance that inhibit prostaglandin

formation and make the clinical signs more severe. With aspirin and penicillin, this will occur at the recommended therapeutic dosages. The effect is not permanent and, following withdrawal of medication, the severity of cramp behavior will return to previous levels. Such drugs should be used with caution in Scottish Terriers known to be affected with Scottie Cramp and the owners should be informed of the probability of increased clinical signs.

Factors Modifying the Expression or Severity of scottie Cramp

The elicitation of an episode is highly dependent upon psychic factors. By identifying those situations in which an episode will predictably be elicited, an owner may reduce the incidence of episodes by not exposing the dog to the stimulus or, if this is not possible, by behaviorally training the dog to accept the stimulus. Potent inducers of an episode may be events such as feeding or going for a walk, which make the dog excited. Fear is also a potent inducer. The authors have had several reports of dogs with Scottie Cramp exhibiting signs when confronted with stairs. In one case, the veterinarian sedated the dog and, through repetitive exposure to stairs, was able to eliminate them as an initiator of cramp. On the other hand, anxiety inhibits the manifestation of the disorder and may explain the difficulty in eliciting clinical signs when a dog is taken to a veterinarian.

Dogs may suppress the elicitation of clinical signs by modifying their activity. Young puppies often exercise freely until severe clinical signs become evident thereafter, the dogs may stop exercising or may modify the intensity of exercise when they feel the beginning of clinical signs. It is, therefore, not uncommon to find clinical signs more prevalent in younger dogs. The owner may think that the adult dog, showing fewer clinical signs, has outgrown the disease.

The environment of the dog may also influence the expression of the disease. Most, if not all, stressful conditions have the potential to modify the clinical signs of Scottie Cramp. This means that dogs, with Scottie Cramp, raised in a quiet home may exhibit fewer clinical signs than dogs raised with other dogs or placed in a more intense environment. Thus, the dog may again appear to grow out of the disorder when taken from the kennel at a young age to a home environment.

If the health status of the dog with Scottie Cramp deteriorates, the clinical signs become more severe. The increase in clinical signs can be marked. When presented with a mature dog that suddenly exhibits clinical signs of Scottie Cramp, it must be realized that the dog was born with scottie Cramp, that the owner did not recognize the dog to have Scottie Cramp, and that some other event is increasing the severity of the clinical signs. The owner and their veterinarian should direct their efforts toward defining these other events. In some cases, if an infectious cause is suspected, the dog may be placed on penicillin-containing antibiotics. This will further increase the severity of clinical signs. With the correction of the primary problem and cessation of treatment, the severity of clinical signs will dissipate and the signs will return to the predisease and pretreatment state. This waxing and then waning have been incorrectly interpreted to mean that the clinical signs observed were due to a drug idiosyncrasy and that the dog does not have Scottie Cramp.

Nutritional factors are also important in determining the severity of clinical signs and altering the diet can be very effective in reducing the clinical signs. Methods that increase the availability of tryptophan may be beneficial in reducing the likelihood that an episode will occur. Glucose administration, for example, will increase the function of serotonergic neurons in affected dogs. Giving the dog a small amount of glucose, such as a chocolate bar, may reduce the clinical signs if given 1 hour prior to exposure to a stressful situation.

Diagnosis of Scottie Cramp

Unfortunately, there is no laboratory test for Scottie Cramp and diagnosis is made on observation of clinical signs. The original diagnostic criteria for Scottie Cramp included a clinical history indicating abnormal locomotion or seizure-like activity during excitement or exercise, exacerbation of the condition following administration of amphetamine, and remission of signs following the administration of diazepam or promazine derivatives.2 The clinical history and the familial history are still highly significant. Pharmacological challenge to elicit an episode of Scottie Cramp is more appropriately performed with drugs that will selectively affect serotonergic neuronal activity, and is recommended only if excited exercise is not effective in eliciting clinical signs. Parachlorophenylalane at 100 mg/kg/day, over a 3-day period, is very effective in increasing the signs of Scottie Cramp. Subclinical, or minimally affected, animals are easily detected by p-CPA treatment because the clinical signs become proportionately more increased than in severely affected dogs. Unfortunately, p-CPA is not readily available for use in veterinary practice and, therefore, is not useful in clinical situations. Methysergide, on the other hand, offers great potential for diagnostic testing of Scottie Cramp. Following oral administration of a single dosage of methysergide, the clinical signs of Scottie Cramp will be increased within a 2-hour period. The effects of methysergide disappear after an 8-hour period. With the exception of some transient nausea and gastrointestinal irritation, side effects are not obvious. Experimentally, clinical signs are easily seen at dosages of 0.1 mg/kg to 0.6 mg/kg. The dose at which there is a 50% increase in clinical signs is 0.3 mg/kg. Exceeding 0.6 mg/kg does not increase the effects of methysergide upon cramp behavior, but does increase the severity of its side effects. The authors recommend starting at a dosage of 0.3 mg/kg, increasing the dosage to 0.6 mg/kg if clinical signs are not seen. If the signs become excessive, treatment with diazepam should decrease them accordingly.

Treatment of Scottie Cramp

Diazepam, at a dosage from 0.5 mg/kg to 1.5 mg/kg, reduces the clinical signs of Scottie Cramp in an acute episode and, if given chronically, also reduces recurrent problems. Diazepam is effective if given at 8-hour intervals. Recently, the beneficial role of vitamin E therapy has been evaluated.e Vitamine E, at doses above 125 IU/kg given once per day, is very effective in elevating the threshold for the elicitation of clinical signs. Vitamin E does not reduce the severity of an episode, but reduces the likelihood that an episode will occur. Doses as low as 70 IU/kg are also effective in reducing cramp behavior but are not recommended for long-term treatments. In severe cases, maintaining the dog on vitamin E and, when needed, diazepam treatment may effectively control the condition.

Conclusion

In summary, Scottie Cramp is common within the breed. It is a genetic disorder which can be observed in most dogs at a young age. Dogs that have Scottie Cramp are not otherwise impaired and make excellent pets. By modifying the behavior, environment or nutrition, the severity of the disorder can be significantly reduced. If there is any question whether a dog is affected, a diagnosis can be obtained using drugs which block serotonin function. It is possible to eliminate the trait from a line and retain desirable characteristics by a controlled breeding program.

Authors Notes: The incidence has not been established, but based on the genetic traits, the probability is at least 25%.

bSansert©, Sandoz Pharmaceuticals, East Hanover, NJ 07936.
cClemmons RM, Meyers KM: Unpublished data.
dClemmons RM, Meyers KM: Unpublished data.
eClemmons RM, Meyers KM: Unpublished data.

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