Clinical features and outcome in dogs and cats with obsessive-compulsive disorder: 126 cases (1989–2000)

Karen L. Overall, VMD, PhD, DACVB, and Arthur E. Dunham, PhD

Objective—To determine clinical features and outcome in dogs and cats with obsessive-compulsive disorder (OCD).

Design—Retrospective study.

Animals—103 dogs and 23 cats.

Procedures—Records of patients with OCD were analyzed for clinical features, medication used, extent of behavior modification, and outcome.

Results—Most dogs affected with OCD had been obtained from breeders. Male dogs significantly outnumbered females (2:1). Female cats outnumbered male cats by 2:1 in a small sample. Most affected dogs lived in households with 2 or more humans and other dogs or cats, and had some formal training. Client compliance with behavior modification was high. A combination of behavior modification and medication resulted in a large decrease in intensity and frequency of OCD in most animals. Clomipramine was significantly more efficacious for treatment in dogs than was amitriptyline. Only 1 dog and 1 cat were euthanized because of OCD during the study.

Conclusions and Clinical Relevance—OCD in dogs does not appear to be associated with lack of training, lack of household stimulation, or social confinement. In cats, OCD may be associated with environmental and social stress. Obsessive-compulsive disorder appears at the time of social maturity and may have sporadic and heritable forms. With appropriate treatment (consistent behavior modification and treatment with clomipramine), frequency and intensity of clinical signs in most dogs and cats may decrease by > 50%. Success appears to depend on client understanding and compliance and the reasonable expectation that OCD cannot be cured, but can be well controlled. (*J Am Vet Med Assoc* 2002;221:1445–1452)

Obsessive-compulsive disorder (OCD) in pet dogs and cats is usually recognized because of a compulsive component (ritualistic, stereotypic behaviors). Obsessive-compulsive behaviors in dogs can include those characterized by circling, tail chasing, flank sucking (particularly in Doberman Pinschers), fence running, fly biting, self mutilation, hair or air biting, pica, pacing or spinning, staring and vocalizing, some aggressions, self-directed vocalizing, and fabric sucking or chewing. In cats, self-mutilation, excessive grooming, tail chasing, and wool or fabric sucking or chewing are also signs of OCD.[1-6] Because behaviors seen in OCD are often normal behaviors performed in an inappropriate, excessive, or out-of-context manner,[7,8] history becomes particularly important in elucidating whether the patient truly has OCD. The purpose of this retrospective study was to determine clinical features, response to treatment, and outcome in dogs and cats with OCD.

From the Biology Department (Dunham) and the Center for Neurobiology and Genetics-Psychiatry Department, School of Medicine (Overall), University of Pennsylvania, Philadelphia, PA 19104.

Data entry was supported by Novartis Animal Health, Greensboro, NC; medication for some patients was provided by CIBA, Summit, NJ, and Novartis Animal Health, Greensboro, NC.

The authors thank Len Rhone and Ken Mullin for technical assistance.

Address correspondence to Dr. Overall.

Criteria for Selection of Cases

All dogs and cats seen at the Behavior Clinic of the University of Pennsylvania from January 1989 through December 2000 were assessed for OCD as part of a thorough history and by use of a standardized questionnaire.[8,a] Inclusion criterion was a diagnosis of OCD made on the basis of finding repetitive, stereotypic motor, locomotory, grooming, ingestive, or hallucinogenic behaviors that occurred out of context or in frequency or duration in excess of that required to accomplish the ostensible goal or in a manner that interfered with the animal's ability to function in its social environment.[7,9,10] As a result of the standardized screening of all patients, the diagnosis of OCD was made for some patients for whom the affiliated behaviors were not the clients' primary complaint, and in a few animals the diagnosis of OCD was secondary to another primary condition (eg, obsessive-compulsive spinning and barking that is particularly performed during bouts of separation anxiety).

Procedures

From the medical records, patients were classified by breed; weight; sex and neuter status; age at neutering; age at onset of OCD; source; number of humans, cats, and dogs in the household; training or schooling; duration of treatment; class of OCD (hallucinatory, vocalization, locomotory, grooming or self-mutilation, ingestion [pica or coprophagy])[1-6,11]; whether other dogs or cats in the household had the same or similar behavior and if so, which animals; concurrent behavioral diagnoses; medication used and duration; extent of behavior modification; and outcome.

For assessment of animal age and duration of OCD, actual birth dates were used when known. If the day was unknown but the month of birth was known, the patient was assigned a birth day of 15. If both month and day were unknown, the patient was assigned a birth date of June 30 of the year suspected to be the birth year.

Sources of animals included stray or found, breeder (serious or show), breeder (backyard), Society for the Prevention of Cruelty to Animals or humane shelter, breed rescue service, newspaper adoption advertisement (not breeder), pet store, friend, and other. Training or schooling categories included no school, trained by client, puppy kindergarten, group lessons (basic), group lessons (advanced), private trainer at house, and private trainer (sent to trainer).

The general behavior modification scheme for dogs consisted of 3 basic steps designed to stop unwanted behaviors and reward preferable behaviors that were directly competitive with the undesirable behaviors. In step 1, clients were to cease even unintentional reward for the undesirable behavior. In step 2, clients were asked to follow a passive behavior modification program designed to teach dogs to sit quietly, look at the person from whom they were seeking attention or with whom the interaction was occurring, and wait to take the cues about the appropriateness of their behavior from those people (ie, Protocol for Deference[8]). In step 3, clients were requested to begin active behavior modification designed to teach the dogs to relax when they would otherwise be engaged in the behavior, in exchange for which the dog was given a food or play reward (ie, Protocol for Relaxation: Tier 1[8]).

For clients with feline patients, steps 1 and 3 were recommended; step 2 was modified to recommend that the client only interact with the cat when the cat was calm. Cats were not required to sit in step 3, although this was encouraged, but the clients were advised to engage the cat in an enjoyable behavior that was directly competitive with the undesirable behavior.

Behavior modification was assessed on the basis of client responses and clinician opinion.

For some of the patients, medication had been prescribed by the referring veterinarian. When the first patient in this study was treated, treatment with **tricyclic antidepressants (TCAs**; eg, clomipramine and **specific serotonin reuptake inhibitors [SSRIs]**) was cost prohibitive (> $10/d). Clomipramine is now affordable and available in a canine formulation.[b] Accordingly, the TCA (amitriptyline) was the first drug of choice for all patients with conditions that primarily involved anxiety and were enrolled in the early portion of the study. Clomipramine was only used instead of amitriptyline if amitriptyline was not efficacious or caused gastrointestinal disorders. Because of its histamine-1 receptor antagonist properties, the TCA doxepin was the first drug of choice for conditions that primarily involved pruritus, followed by amitriptyline.[8,12-14] Other medications were occasionally prescribed as dictated by alterations in the patients' behaviors, and for some animals, combinations of medications were both more efficacious and more cost-effective for clients, as described elsewhere.[13]

When the senior author was awarded a grant providing clomipramine at no cost, clomipramine was used as the first drug of choice for treating OCD, as it has been in humans. This circumstance allowed us to retrospectively compare the relative effects of amitriptyline and clomipramine for patients that met the criteria for OCD. If a patient was administered amitriptyline and acceptable results were obtained (marked decrease in intensity and frequency of OCD behaviors), administration of the drug was maintained and treatment was considered successful. If a patient was treated initially with amitriptyline and acceptable results were not obtained, clomipramine was administered instead; if acceptable results were obtained with clomipramine, treatment with amitriptyline was considered a failure and treatment with clomipramine was considered a success. Patients for whom treatment with clomipramine failed were likewise treated with another medication.

Dosage protocols[13] were used consistently and included amitriptyline (1 mg/kg [0.45 mg/lb], PO, q 12 h for 10 days; if no change in behavior was detected, the dosage was increased to 2 mg/kg [0.91 mg/lb] for 10 days; if still no change was detected, the medication was changed [if treatment was efficacious it was continued for a minimum of 1 month]); doxepin (3 to 5 mg/kg [1.4 to 2.3 mg/lb], PO, q 8 h to q 12 h for a minimum of 1 month); clomipramine (1 mg/kg, PO, q 12 h for 14 days, then 2 mg/kg, PO, q 12 h for 14 days, then 3 mg/kg, PO, q 12 h for 1 month, for a minimum of 2 months of treatment [the gradual increase in dosage was intended to minimize gastrointestinal disorders]); and the SSRIs, sertraline and fluoxetine (1 mg/kg, PO, q 24 h for 2 months initially). Treatment was then continued at the minimum effective dose necessary to control the behavior.

All patients received full physical and laboratory evaluation prior to treatment. Any nonspecific dermatologic, medical, or neurologic signs potentially associated with OCD were evaluated by the veterinarians trained in the respective specialty prior to behavioral treatment. When warranted, patients also received various nonroutine diagnostic procedures (eg, assessment of thyroid function and magnetic resonance spectroscopy of the brain).

Eight clinicians were involved in evaluation of the dogs reported here. All clinicians adhered to the same diagnostic criteria, and at least 2 clinicians reviewed each diagnosis. Although many records contained detailed outcome data, quality of the description of the behaviors depended on clinician expertise versus resident expertise, whether the behaviors were videotaped, client capability and motivation in keeping data logs, and knowledge accrued by managing increasing numbers of these dogs. Accordingly, outcomes were broadly grouped and statistically treated as class variables to evaluate older and newer cases equivalently. Response variables for outcome were small decrease in intensity (≤ 50%), large decrease in intensity (> 50%), small decrease in frequency (≤ 50%), large decrease in frequency (> 50%), the behavior stopped totally, no change, small increase in intensity (< 50%), large increase in intensity (> 50%), small increase in frequency (< 50%), large increase in frequency (> 50%), died, euthanized because of OCD, euthanized for other reasons, placed, other, and unknown. Patients classified with unknown outcomes were those lost to follow-up. For patients with concurrent behavioral diagnoses, alterations in intensity and severity reported here pertain only to OCD.

Data were analyzed by use of the log-likelihood ratio test, and relevant nonparametric tests as indicated for categoric data.[c]

Results

One hundred three dogs met inclusion criteria, including 5 sexually intact females, 26 spayed females, 20 sexually intact males, and 52 neutered males. Twenty-three cats (1 sexually intact female, 14 spayed females, 1 sexually intact male, and 7 neutered males) that met the diagnostic criteria had sufficiently complete records to be included in the study.

Category of OCD—The most common category of OCD in dogs was that associated with grooming or self-mutilation, followed by OCD involving locomotion and OCD involving signs of hallucinations (**Fig 1**). For cats, the most common category of OCD involved grooming or self-mutilation (**Fig 2**).

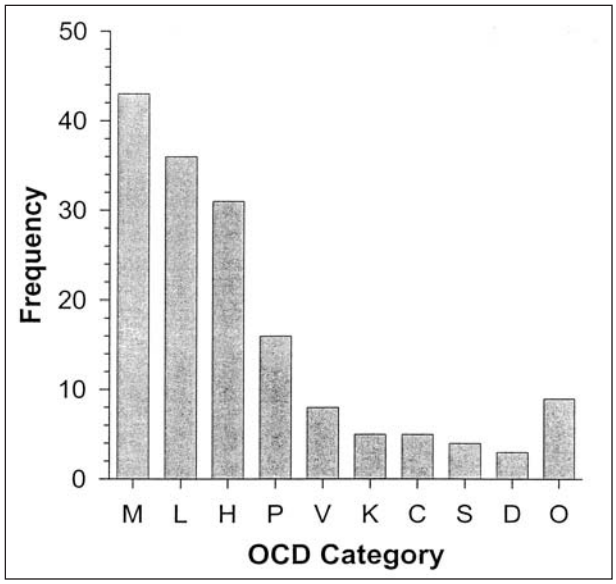

Figure 1—Frequency (%) distribution of categories of obsessive-compulsive disorder (OCD) in 103 dogs. M = Self-mutilation (grooming). L = Locomotor (spinning, chasing). H = Hallucinatory. P = Pica. V = Vocalization. K = Licking. C = Coprophagy. S = Sucking. D = Digging. O = Other.

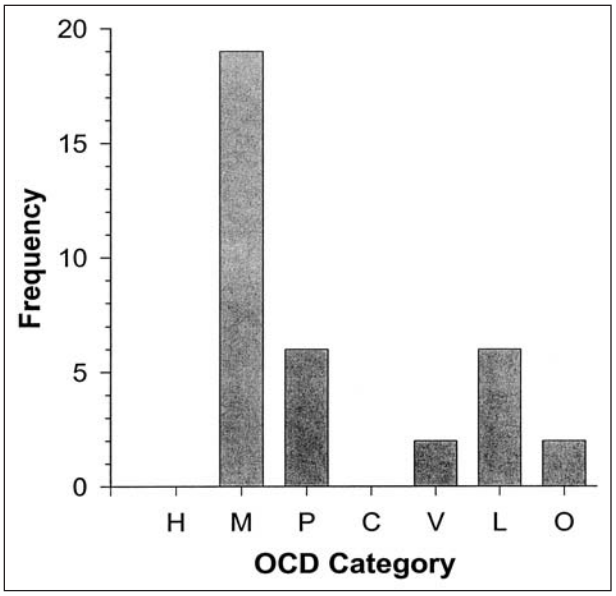

Figure 2—Frequency (%) distribution of categories of OCD in 23 cats. *See* Figure 1 for key.

There was no significant association (log likelihood ratio test) between sex and neuter status category of affected dogs and the category of OCD they had. However, compared with the sex and neuter data for the entire veterinary teaching hospital canine population during the study period (n = 47,473), male dogs were significantly over-represented in the OCD population (log likelihood ratio test statistic, $G_{adjusted\ (adj)}$ = 13.256 [$P < 0.05$]). In addition, neutered males were over-represented in the OCD population, compared with non-neutered males (log likelihood ratio test statistic, G_{adj} = 36.641 [$P \leq 0.001$]).

Breed—The population of dogs with OCD comprised 18 mixed-breed dogs; 12 German Shepherd Dogs; 7 Rottweilers; 6 Golden Retrievers; 5 each of Dalmatians, Labrador Retrievers, and Lhasa Apsos; 3 each of Doberman Pinschers, Poodles, Soft-Coated Wheaten Terriers, and English Springer Spaniels; 2 each of American Pit Bull Terriers, Bulldogs, Great Danes, Miniature Schnauzers, and Cocker Spaniels; and 1 dog each of 22 other breeds. This distribution did not differ significantly from that in the overall canine population of the Behavior Clinic or of the veterinary teaching hospital. Further examination of the most common breeds of dogs (mixed breeds, German Shepherd Dogs, Rottweilers, Dalmations, and Bulldogs) revealed interesting patterns among the breeds. The specific manifestations of the OCD appeared to be associated with the tasks for which the dogs were developed. Dogs of herding breeds often had excessive tail chasing. Dogs of guarding breeds and those selected for intense focus and tenacity (eg, Dalmatians, Rottweilers, and German Shepherd Dogs) often had signs of hallucinations. All Rottweilers and all but 1 Dalmatian had signs of hallucinations. Nine of 12 German Shepherd Dogs chased their tails.

The cat population consisted of 14 Domestic Shorthairs, 6 Siamese, 1 Devon Rex, 1 Russian Blue, and 1 Bengal. Siamese cats commonly had pica involving sucking, chewing, or ingestion of fabrics; 2 of the 6 Siamese cats in the study chewed, sucked, or ingested fabric; and 1 ingested electric cords. All cats that ingested fabric were Siamese, but neither cats that licked plastic substrate or had sucking behavior category were. The Bengal cat had over-grooming and urine marking, both anxiety-related conditions. The small number of cats we evaluated precluded statistical comparisons among breeds. The behaviors associated with OCD appeared after trauma in 3 cats and after changes in feline or human social circumstances or relationships in 7 cats. The changes in the feline or human relationships were also often associated with intercat aggression or elimination abnormalities (9 cats). Grooming or self-mutilation involved 16 of the cats, 3 of which had a previous diagnosis of hyperesthenia and 3 of which had a diagnosis of atopy.

Age of onset—Age of onset was known or confidently estimated for 95 of the 103 dogs. Mean ± SD age at onset was 20.3 ± 23.7 months; however, the frequency distribution of age at onset was highly skewed (skewness, 3.214). Age of onset for cats was 28.2 ± 30.1 months (n = 21), and the frequency distribution

was less skewed (skewness, 1.14) than that of the dog population. Median age of onset for cats and dogs was 12 months, indicating that half of the patients developed signs of OCD by the age of 1 year.

Source—Almost 60% of the dogs in this study originated from either serious show breeders (54.4%) or backyard breeders (4.9%). These categories were self-assigned by the dog owners, so the low percentage of backyard breeders may have been an underestimate. Only 9% of dogs came from pet stores, whereas 11% came from humane shelters.

Six of the cats came from friends, 5 came from either serious show breeders or backyard breeders, 5 were found or were stray, 3 came from humane shelters, and 4 came from miscellaneous sources.

Size of human and pet households—Only 18 (17.5%) of the dogs in this study lived in single-human households; 46 (44.7%) lived in households with 2 humans, and 39 (37.7%) lived in households with 3 or more humans. More than half of the dogs in this study had other dogs in the household, and almost 30% had cats in the same household.

Most of the cats lived in households with 2 or more humans (n = 18). Fifteen cats lived with other cats; 11 lived in 2-cat households, and 4 lived in households with 3 or more cats. Few cats (n = 3) with OCD had dogs in their household.

Training for dogs—Most dogs in this study had what is considered to be basic training of some kind; 6 (5.9%) attended puppy kindergarten, 20 (19.6%) attended basic group lessons, 10 (9.8%) attended advanced group lessons, 17 (16.7%) had a private trainer come to their house, and 3 (2.9%) were sent to a private trainer.

Client compliance with treatment—Only 3% of canine clients admitted to performing none of the behavior modification. For 17% of the patients, compliance data were unavailable. Sixty-three percent of the clients either complied extensively (38%) or consistently (25%). Twenty percent complied intermittently. Client compliance for treatment in cats was also high.

Treatment outcomes for dogs and cats were calculated (**Fig 3 and 4**). Percentage frequencies of dogs with large decreases in intensity and dogs with large decreases in frequency of behavioral problems were significantly associated (Cochran-Mantel Haenzel test statistic G_{adj} = 59.87; df = 1; $P < 0.001$). Other outcomes included unknown (14 dogs were lost to follow-up), small increase in intensity but a large decrease in frequency of episodes (n = 1), death unrelated to OCD (1), euthanasia for OCD (1), and euthanasia for reasons unrelated to OCD (8).

Efficacy of medication—Of the 103 dogs in this population, 84 were treated with 1 or more drugs. Nineteen clients declined a drug treatment option for their dog. There were sufficient data only to compare the relative success rates for amitriptyline and clomipramine (**Table 1**). The observed success rate for clomipramine (0.83) was significantly greater than that

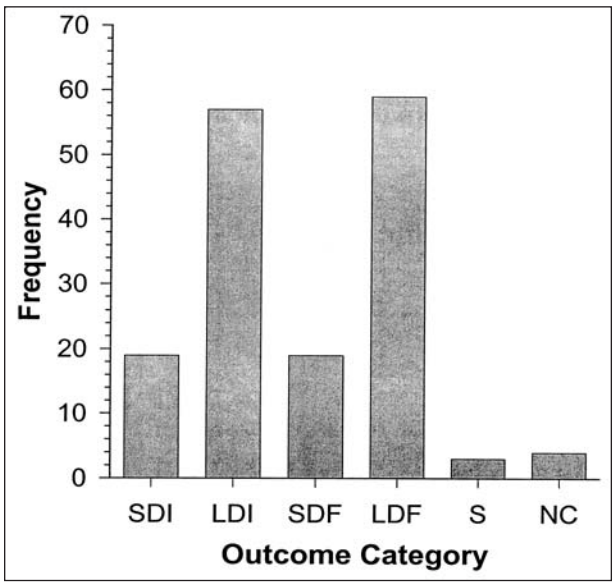

Figure 3—Outcomes for 103 dogs treated for OCD. SDI = Small decrease in intensity of OCD (≤ 50%). LDI = Large decrease in intensity (> 50%). SDF = Small decrease in frequency of OCD behavior (≤ 50%). LDF = Large decrease in frequency (> 50%). S = Stopped OCD behavior completely. NC = No change.

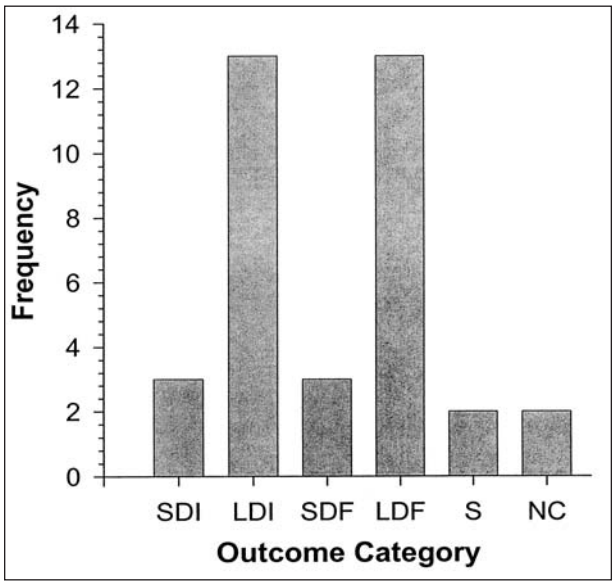

Figure 4—Outcomes for 20 cats treated for OCD. *See* Figure 3 for key.

(0.59) for amitriptyline (log likelihood ratio test statistic G_{adj} = 6.03; $P < 0.05$).

Duration of treatment—Dogs for which complete information was available (n = 80) were treated for a mean of 14.1 months, a median of 12 months, and a range of 6 to 78 months. Cat data were insufficient for analysis, but the range of continuous treatment was 2 to 4 months. All cats from which medication was withdrawn (n = 9) relapsed and drug treatment was reinstated.

Affected relatives—Clients knew whether relatives were also affected with some form of OCD for only 30 of the 103 dogs in this study; 15 dogs had

Table 1—Drug treatment and evaluation of success versus failure in 89 dogs and 20 cats with obsessive-compulsive disorder

Drug	No. of Successes	No. of Failures	Probability of success
Amitriptyline[d]	32	22	0.593
Clomipramine[b,e]	30	6	0.833
Fluoxetine[f]	8	1	0.889
Buspirone[g]	1	1	0.500
Alprazolam[h,*]	1	0	1.000
Hydroxyzine[i,†]	3	0	1.000
Doxepin[i,‡]	1	2	0.333
Sertraline[k]	1	0	1.000
Prednisone[§]	1	0	1.000
Pentazocine[l]	1	0	1.000
Diazepam[m,‖]	3	0	1.000

*Used in combination with clomipramine to treat signs of panic. †Used for pruritus associated with lesion caused by grooming in cats. ‡Used for pruritus associated with lesions caused by grooming in dogs. §For treatment of putative intervertebral disk disease. ‖Used in combination with amitriptyline (2 animals) and clomipramine (1 animal) for signs of panic.

affected relatives and 15 did not. Of the 15 dogs with affected relatives, 7 had 1 known affected relative (3 male littermates, 3 sires, and 1 dam), 7 had 2 known affected relatives (female littermate-male littermate, sire-male offspring, sire-other, grandsire-other, dam-male littermate, dam-second degree relative), and 1 had 3 known affected relatives. Only 3 clients with cats knew about affected relatives, and only 2 of these definitely had an affected relative (1 sire, 1 offspring).

Concurrent behavioral diagnoses—Seventy-seven (74.8%) dogs had concurrent behavioral conditions, as determined via published diagnostic criteria.[8] Thirty-three (32.0%) dogs met the criteria for a diagnosis of attention-seeking behavior (eg, excessive solicitation and neediness), 29 (28.2%) met the criteria for a diagnosis of dominance or impulse-control aggression, 23 (23.3%) met the criteria for a diagnosis of separation anxiety, and 16 (15.5%) met the criteria for a diagnosis of generalized anxiety disorder. Thirty other miscellaneous behavioral and medical diagnoses were also noted. There was no association between duration that the dog had been affected before treatment and the number of concurrent behavioral diagnoses ($r = 0.13$; $P = 0.23$). Because many dogs in this study had multiple concurrent behavioral diagnoses, the sample sizes of each diagnostic combination were insufficient to determine whether the associations were random, as has been performed elsewhere.[15] The data were also insufficient to assess whether dogs that had been affected longer had more intense or more frequent signs of OCD, compared with dogs affected for a short period.

In contrast with dogs, only 9 of 23 (39.1%) cats met the criteria for concurrent behavioral diagnoses, a difference that was significant (log likelihood ratio test, $G_{adj} = 10.04$; $P < 0.05$). In contrast with dogs, most of the concurrent behavioral diagnoses were associated with elimination disorders; 3 cats also sprayed, 2 cats urine-marked without spraying, 1 cat marked with feces, and 1 cat had a substrate aversion to the litter. Only 1 cat met the criteria for separation anxiety, a major concurrent diagnosis in dogs.

Discussion

Stereotypic behaviors may or may not be associated with OCD.[1-5,7] Differential diagnoses for other behavioral conditions in which the nonspecific signs associated with OCD can occur include environmental causes, management, humane considerations (eg, those involving understimulation, neglect, or excessive confinement), separation anxiety, attention-seeking behavior, generalized anxiety, and hyperactivity.[7,8]

Obsessive-compulsive disorder in all species is characterized by repetitive, ritualistic behaviors, in excess of any required for normal function, the execution of which interferes with normal, daily activities and functioning. Inherent in this description is a behavior that is exaggerated in form as well as duration. The diagnostic criteria employed here have dual advantages. First, they permit separation of nonspecific signs from diagnostic criteria. This allows the nonspecific signs to be used to evaluate changes in the condition and to further describe populations afflicted with different manifestations of the condition.[15,16] Second, they do not require definition or assessment of underlying motivational states, which is difficult to accomplish in a meaningful manner in other species.

It appears that dogs, as do humans, may perceive that their behaviors are abnormal and control their behaviors to the extent that the behavior is performed only minimally, or not at all, in the presence of others. Dogs who flank suck or tail chase may, after frequent reprimands and corrections, remove themselves from view and then commit the behavior elsewhere. Upon approach, the behavior ceases, only to begin again when no one is watching or when the animal removes itself from view. Results of this study support the existence of this evasive behavior pattern. If the desire to perform the behavior is present, despite restraint because of punishment, training, or physical incarceration, the condition is present. The key is that if such control is removed and the animal can commit the behavior, it will commit the behavior. Ignoring this crucial point will result in underdiagnosis of OCD and underestimation of its frequency in canine and feline populations.

The presence of this and other cognitive components suggests that the problem is rooted at a higher level than the behavior alone may indicate (ie, a Doberman Pinscher may be flank sucking, but not because anything is wrong with its flank). Such examples support the contention that obsessions are a valid component of OCD. We evaluate obsessions in humans by asking them about repetitive, invasive thoughts.[17] It is inappropriate to apply a criterion (eg, assessment that relies on a verbal response) to 1 species that has a divergent phylogeny (eg, nonverbal) that prohibits the use of that tool or criteria.[10] The extent to which the patients in our study focused on their behaviors, avoided those who sought to interfere with them, and were avoided by clinically normal or unaffected canine and feline housemates strongly suggests that a cognitive component was present, albeit difficult to assess.

Obsessive-compulsive disorder in humans frequently appears in adolescence, at the onset of social

maturity, and continues through midlife. In dogs and cats, OCD also appears during this indistinct period of social maturity (range for dogs, 12 to 36 months; mean, approx 18 to 24 months; range for cats, 24 to 48 months; mean, approx 30 to 36 months)[8] and if left untreated, whether by behavioral or pharmacologic intervention, it worsens. Given the relatively early age at which this condition develops and the probability of profound deterioration when left untreated, young animals should be routinely screened for OCD and treated appropriately early. Dogs and cats from families with a history of OCD should be carefully watched for its appearance, albeit possibly in a different form than that of their relatives.

In this study, 10 of the 23 affected cats had signs of their particular form of OCD after some physical trauma or social upheaval, and the OCD in these cats may have occurred concomitant with intercat aggression or elimination problems. Siamese cats were ranked as the second most common breed in this study. Although this does not differ substantially from their rank in the overall hospital population (3), it is dramatically different from the breed rank in our Behavior Clinic population (22), suggesting that when a Siamese cat is evaluated because of a behavioral problem, the behavior is likely associated with OCD. Siamese cats were most often involved in ingestion of fabric, supporting other findings regarding increased prevalence of OCD in Oriental-breed cats,[18] but there were too few members of each breed to reach breed-related conclusions. It is interesting that the only Bengal cat in the study population had self-mutilation and urine marking. These are both anxiety-related conditions and may have some association with the relatively recent domestication of this breed. Most cats affected with OCD had self-mutilation or excessive grooming. No cats were reported to have signs of hallucinating; however, hallucinations may have been associated with tail chasing. Most owners of these cats reported that the cats acted as if something was on or near the cat's tail and that the cat was either trying to chase this entity or escape it. Accordingly, feline hallucinations may not have been adequately identified in this study.

Unlike cats, few dogs had OCD after trauma or social-situational distress or upheaval, and few had concurrent behavioral diagnoses involving elimination or social relationships with other dogs. These data suggest that the behavioral characteristics, neuroanatomic regions affected, and molecular and neurogenetic mechanisms of OCD may differ for dogs and cats. Two dogs had OCD after physical trauma. In both dogs, the trauma consisted of abusive training (hanging by a choke collar). That 2% of this population of dogs with OCD was subject to such abuse should be of concern to all veterinarians.

One pet-store dog had profound coprophagia, suggesting that at some point coprophagia may have represented a nutritional strategy. Of the 103 dogs, few (approx 10%) had a putative neurologic disorder, physical condition, or potentially painful disorder associated with OCD, which could either be primary or secondary to OCD. One dog had a diagnosis of irritable bowel syndrome, a diagnosis that may be simply a nonspecific sign of an anxiety-related condition. This finding supports the hypothesis that OCD in dogs is based in some primary neurochemical or neurogenetic dysfunction, and that the mechanisms driving OCD may differ between dogs and cats.

Obsessive-compulsive disorder affects at least 2% of the human population, and this is believed to be an underestimate.[19-21] Some forms of OCD have a familial genetic component[22-24]; however, most instances of human OCD appear to be sporadic. It is important to recognize that the development of specific animal breeds and the practice of inbreeding within those breeds suggest that the prevalence of OCD in dogs could be higher than that reported for humans.

On the basis of client interviews and complaints, OCD may be familial in Great Danes, German Shorthaired Pointers, German Shepherd Dogs, Bull Terriers,[25] Jack Russell Terriers, Dalmatians, Bouvier de Flanders, Salukis, Cairn Terriers, Basset Hounds, and Soft-Coated Wheaten Terriers.[10] The strong correlations between canine breeds and forms of OCD we detected strongly suggest a genetic basis for OCD, albeit, in part as the result of genetic limitations and subsequent potential decreases in genetic heterogeneity associated with breed.

As is true for humans, first-degree relatives usually have a different form of OCD than the proband, which supports the hypothesis of a heritable, neurochemically variable basis for OCD. That 50% of the dogs in this study for which familial data were known had a relative affected with some form of OCD strongly suggests 2 important points: certain breeds of dogs appear to have a high prevalence of OCD, perhaps higher than that in the human population, and a larger proportion of canine relatives are affected than appears true for humans. This strongly suggests a genetic component for OCD in dogs.

Results of recent studies indicate that OCD in humans is the result of dysfunction of genes involving neurochemical and intracellular regulatory systems.[26,27] Similar complex regulatory systems that have a genetic, heritable basis have also been reported for dogs[28] and may be involved in OCD.[29]

Human OCD has been postulated to be caused by aberrant serotonin metabolism.[30-32] Accordingly, treatment has been directed at affecting serotonergic metabolism; pharmacological agents used for treatment are fairly specific and affect subclasses—primarily the 5-HT_{1A} class—of serotonin receptors. Neuropharmacologic approaches to treatment have sought to address such regulatory abnormalities by augmenting serotonin through the use of TCAs and SSRIs.[33-39] The key to the success of the specific TCAs and SSRIs over other classes of medication is that they use the same second messenger systems and transcription pathways that are used to develop cellular memory (ie, learning).[40,41]

While the best design for comparing drug efficacy is a prospective, placebo-controlled, double-blind study, other statistical comparisons can be made if criteria for switching medications are consistent, as was the case here. Such techniques are underused in veterinary medicine, which is unfortunate since the funding and large enrollment pools required for the former are

seldom available. As is true for humans, dogs with OCD respond well to the TCA, clomipramine,[7,11,18,25] and to the SSRI, fluoxetine.[42-46] Results of the study reported here indicated that clomipramine was superior for treatment of OCD in dogs, compared with amitriptyline. The difference in efficacy is likely associated with specificity for the serotonin 1A subtype (5-HT_{1A}) receptor of the parent compound and at least 1 of the intermediate metabolites that acts as a SSRI.[35,40] This specificity may also be responsible for the success of fluoxetine in the treatment of some forms of OCD,[47,48] although our sample size was not sufficient to test this hypothesis.

Adverse effects appear rare in canine patients; the most common adverse effects have been gastrointestinal disorders.[11,49] Use of TCAs is contraindicated in animals with a history of urinary retention and severe, uncontrolled cardiac arrhythmias.[50]

It is surprising that amitriptyline was at all efficacious (32/54 animals) in the treatment of OCD in our study. Although not the drug of choice for treatment of OCD in humans, this relatively nonspecific TCA may sufficiently decrease nonspecific anxiety so that patients can learn to change their behavior. At present, we have no way to evaluate how advanced OCD is when it is diagnosed in dogs and cats. Early signs may go unnoticed. The success associated with treatment with amitriptyline may reflect that some animals have less severe forms of OCD and fewer comorbid diagnoses. No animals with long-term OCD and multiple concurrent behavioral diagnoses improved when treated with amitriptyline alone in this study.

In our study, 74.8% of the canine patients, but only 39.1% of the feline patients, had concurrent behavioral diagnoses. When considered in light of the relative role apparently played by environmental factors in OCD for these 2 species and the divergent evolutionary and domestication histories of dogs and cats, caution is urged in assuming that OCD is mechanistically the same in these 2 species. This finding could be fortuitous and lead us to a clearer understanding of a condition that is multifactorial and has both genetic and sporadic forms. Furthermore, the high rate of concurrent primary anxiety disorders (attention-seeking behavior, separation anxiety, and generalized anxiety disorder) in dogs affected with OCD suggests that as 1 anxiety-related condition progresses, other conditions may represent manifestations of additional underlying neurochemical and molecular changes.[45,51]

Few dogs or cats in our study had complete cessation of behaviors associated with OCD, although most clients complied with the treatment protocols; however, none became worse as a result of treatment and only 1 dog and 1 cat were euthanatized because of OCD. Treatment with medication (clomipramine) and behavior modification was extremely successful; however, mean canine treatment time was 14.1 months, and more than half of all canine patients were treated for > 12 months. This is important because the label instructions for clomipramine for treatment of separation anxiety suggest a shorter treatment period. There is considerable variation between individual dogs in plasma concentrations. In dogs, clomipramine reaches steady-state concentrations in 3 to 5 days, peak plasma concentrations are attained in approximately 1 to 3 hours, the half-life of the parent compound is 1 to 16 hours, and the half-life of the active intermediate metabolites is 1 to 2 hours.[52,53] These data suggest that dogs may require higher dosages or more frequent dosing than do humans treated with such medications. Should the medication be discontinued, relapses occur in many cases.[8,13] Signs also worsened or became more pronounced in stressful or anxiety-inducing circumstances for some patients in our study. Use of clomipramine to treat OCD in animals is extralabel usage in the United States.

---

[a]Available from corresponding author upon request.
[b]Clomicalm, Novartis Animal Health, Greensboro, NC.
[c]SAS, SAS Institute Inc, Cary, NC.
[d]Amitriptyline, Stuart, Wilmington, Del.
[e]Clomipramine, Ciba-Geigy, Summit, NJ.
[f]Fluoxetine, Eli Lilly & Co, Indianapolis, Ind.
[g]Buspirone, Mead Johnson Pharmaceuticals, division of Bristol-Myers Squibb Co, Princeton, NJ.
[h]Alprazolam, Upjohn, New York, NY.
[i]Hydroxyzine, Roering, New York, NY.
[j]Doxepin, Roering, New York, NY.
[k]Sertraline, Pfizer Animal Health, Groton, Conn.
[l]Pentazocine, Winthrop, NC.
[m]Diazepam, Roche, New York, NY.

References

1. Luescher UA, McKeown DB, Halip J. Stereotypic or obsessive-compulsive disorders in dogs and cats. *Vet Clin North Am Small Anim Pract* 1991;21:401–413.

2. Overall KL. Recognition, diagnosis, and management of obsessive-compulsive disorders. *Canine Pract* 1992;17(2):40–44.

3. Overall KL. Recognition, diagnosis, and management of obsessive-compulsive disorders. *Canine Pract* 1991;17(3):25–27.

4. Overall KL. Recognition, diagnosis, and management of obsessive-compulsive disorders. *Canine Pract* 1992;17(4):39–43.

5. Hewson CJ, Luescher UA, Ball RO. The use of chance corrected agreement to diagnose canine compulsive disorder: an approach to behavioral diagnosis in the absence of a 'gold standard'. *Can J Vet Res* 1999;63:201–206.

6. Hewson CJ, Luescher UA, Ball RO. Measuring change in the behavioral severity of canine compulsive disorder: the construct validity of categories of change derived from two rating scales. *Appl Anim Behav Sci* 1998;60:55–68.

7. Overall KL. Use of clomipramine to treat ritualistic stereotypic motor behavior in three dogs. *J Am Vet Med Assoc* 1994;205:1733–1741.

8. Overall KL. *Clinical behavioral medicine for small animals*. St Louis: Mosby Year Book Inc, 1997;209–250, 404, 410–423, 508–520.

9. Overall KL. Self-injurious behavior (SIB) and obsessive-compulsive disorder in domestic animals. In: Shuster L, Dodman N, eds. *Psychopharmacology of animal behavior disorders*. Boston: Blackwell Science, 1998;222–252.

10. Overall KL. Dogs as "natural" models of human psychiatric disorders: assessing validity and understanding mechanism. *Prog Neuropsychopharmacol Biol Psychiatry* 2000;24:727–276.

11. Hewson CJ, Luescher A, Parent JM, et al. Efficacy of clomipramine in the treatment of canine compulsive disorder. *J Am Vet Med Assoc* 1998;213:1760–1766.

12. Gupta M, Gupta AK, Ellis CN. Antidepressant drugs in dermatology. *Arch Dermatol* 1987;123:647–652.

13. Overall KL. Pharmacological treatment in behavioral medicine: the importance of neurochemistry, molecular biology, and mechanistic hypotheses. *Vet J* 2001;62:9–23.

14. Shanley KS, Overall KL. Psychogenic dermatoses. In: Kirk

RW, Bonagura JD, eds. *Kirk's current veterinary therapy XI. Small animal practice*. Philadelphia: WB Saunders Co, 1992;552–558.

15. Overall KL, Dunham AE, Frank D. Frequency of nonspecific clinical signs in dogs with separation anxiety, thunderstorm phobia, and noise phobia, alone or in combination. *J Am Vet Med Assoc* 2001;219:467–473.

16. Mojtabai R, Rieder RO. Limitations of the symptom-oriented approach to psychiatric research. *Br J Psychiatry* 1998;173: 198–202.

17. American Psychiatric Association. *DSM-IV. Diagnostic and statistic manual of mental disorders*. 4th ed. Washington, DC: APA Press, 1994;417–423.

18. Seksel K, Lindeman MJ. Use of clomipramine in the treatment of anxiety-related and obsessive-compulsive disorders in cats. *Aust Vet J* 1998;76:317–321.

19. Robins LN, Helzer JE, Weisman MM. Lifetime prevalence of specific psychiatric disorders in three sites. *Arch Gen Psychiatry* 1984;41:949–958.

20. Karno M, Golding I, Sorenson S, et al. The epidemiology of obsessive compulsive disorder in five U.S. communities. *Arch Gen Psychiatry* 1988;45:1094–1099.

21. Flamment M, Whittaker A, Rapoport J, et al. Obsessive compulsive disorder in adolescence: an epidemiological study. *J Am Acad Child Adolesc Psychiatry* 1988;27:764–771.

22. Pauls DL, Alsobrook JP, Goodman W, et al. A family study of obsessive-compulsive disorder. *Am J Psychiatry* 1995;152:76–84.

23. Nestadt G, Samuels JF, Bienvenu OJ, et al. A family study of obsessive-compulsive disorder. *Arch Gen Psychiatry* 2000;57: 358–363.

24. Grados MA, Riddle MA, Samuels JF, et al. The familial phenotype of obsessive-compulsive disorder in relation to tick disorders: the Hopkins OCD family study. *Biol Psychiatry* 2001;50:559–565.

25. Moon-Fanelli AA, Dodman NH. Description and development of compulsive tail chasing in terriers and response to clomipramine treatment. *J Am Vet Med Assoc* 1998;212:1252–1257.

26. Nestadt G, Lan T, Samuels JF, et al. Complex segregation analysis provides compelling evidence for a major gene underlying obsessive-compulsive disorder (OCD) and heterogeneity by gender. *Am J Hum Genet* 2000;67:1611–1616.

27. Greer JM, Capecchi MR. Hoxb8 is required for normal grooming behavior in mice. *Neuron* 2002;33:23–34.

28. Mignot E. A commentary on the neurobiology of the hypocretin/orexin systems. *Neuropsychopharmacology* 2001;25: S5–S15.

29. deBoer T, Stoof JC, van Duijn H. The effects of convulsant and anticonvulsant drugs on the release of radio labeled GABA, glutamate, noradrenaline, serotonin, and acetylcholine from rat cortical slices. *Brain Res* 1982;253:153–160.

30. Jacobs BL, Wilkinson LO, Fornal CA. The role of brain serotonin: a neurophysiologic perspective. *Neuropsychopharmacology* 1989;3:473–479.

31. Murphy DL. Neuropsychiatric disorders and the multiple human brain serotonin receptor subtypes and subsystems. *Neuropsychopharmacology* 1990;3:457–471.

32. Altemus M, Pigott T, Kalogeras K, et al. Abnormalities in the regulation of vasopressin and corticotropin releasing factor secretion in obsessive-compulsive disorder. *Arch Gen Psychiatry* 1992;49: 9–20.

33. Thoren P, Asberg M, Cronholm B. Clomipramine treatment of obsessive-compulsive disorder. *Arch Gen Psychiatry* 1980;37: 1281–1285.

34. Flament MF, Rappoport JL, Berg CJ. Clomipramine treatment of childhood obsessive-compulsive disorder. A double-blind controlled study. *Arch Gen Psychiatry* 1985;42:977–983.

35. Ananth J. Clomipramine: an antiobsessive drug. *Can J Psychiatry* 1986;31:253–258.

36. Zohar J, Insel TR, Zohar-Kadouch RC, et al. Serotonergic responsivity in obsessive compulsive disorder; effects of chronic clomipramine treatment. *Arch Gen Psychiatry* 1988;45:167–172.

37. Perse T. Obsessive-compulsive disorder: a treatment review. *J Clin Psychiatry* 1988;49:48–55.

38. McTavish D, Benfield P. Clomipramine: an overview of its pharmacological properties and a review of its therapeutic use in obsessive-compulsive behavior and panic attack. *Drugs* 1990;39: 136–153.

39. Blier P, deMontigny C, Chaput Y. A role for the serotonin system in the mechanism of action of antidepressant treatments: preclinical evidence. *J Clin Psychiatry* 1990;51(suppl):14–20.

40. Duman RS. Novel therapeutic approaches beyond the serotonin receptor. *Biol Psychiatry* 1998;44:324–335.

41. Duman RS, Heninger GR, Nestler EJ. A molecular and cellular theory of depression. *Arch Gen Psychiatry* 1997;54:597–606.

42. Wynchank D, Berk M. Behavioural changes in dogs with acral lick dermatitis during a 2 month extension phase of fluoxetine treatment. *Hum Psychopharmacol Clin Exp* 1998;13:435–437.

43. Wynchank D, Berk M. Fluoxetine treatment of acral lick dermatitis in dogs: a placebo-controlled randomized double blind trial. *Depress Anxiety* 1998;8:21–23.

44. Overall KL. Animal behavior case of the month. *J Am Vet Med Assoc* 1995;206:629–632.

45. Dodman NH, Donnelly R, Shuster L, et al. Use of fluoxetine to treat dominance aggression in dogs. *J Am Vet Med Assoc* 1996;209: 1585–1587.

46. Overall KL. Rational use of behavioral pharmacology. *Vet Clin North Am Small Anim Pract* 1997;27:637–665.

47. Murphy D, Pato M, Pigott T. Obsessive-compulsive disorder: treatment with serotonin-selective uptake inhibitors, asapirones, and other agents. *J Clin Psychopharmacol* 1990;10:91S–100S.

48. Tollefson GD, Rampey AH, Potvin JH, et al. A multicenter investigation of fixed-dose fluoxetine in the treatment of obsessive-compulsive disorder. *Arch Gen Psychiatry* 1994;51:559–567.

49. King J, Simpson B, Overall KL, et al. Treatment of separation anxiety in dogs with clomipramine. Results from a prospective, randomized, double-blinded, placebo-controlled clinical trial. *J Appl Anim Behav Sci* 2000;67:255–275.

50. Reich MR, Ohad DG, Overall KL, et al. Electrocardiographic assessment of antianxiety medication in dogs and correlations with serum drug concentration. *J Am Vet Med Assoc* 2000;216:1571–1575.

51. Lueger RJ, Lutz W, Howard KI. The predicted and observed course of psychotherapy for anxiety and mood disorders. *J Nerv Ment Dis* 2000;188:127–134.

52. Hewson CJ, Conlon PD, Luescher UA, et al. The pharmacokinetics of clomipramine and desmethylclomipramine in dogs: parameter estimates following a single oral dose and 28 consecutive daily oral doses of clomipramine. *J Vet Pharmacol Ther* 1998;21:214–222.

53. King JN, Maurer MP, Altmann B, et al. Pharmacokinetics of clomipramine in dogs following single-dose and repeated-dose oral administration. *Am J Vet Res* 2000;61:80–85.