

CANINE AGGRESSION: RISK ASSESSMENT, PROGNOSIS, AND SAFETY

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Before implementing a treatment program for canine aggression, a behavioural consultation is required to determine the diagnosis, prognosis, and what must be implemented to safely manage the problem. Prevention of further repetition is essential to insure safety as well as to prevent further aggravation of the problem which is further conditioned each time the dog is exposed to the stimulus with an unpleasant outcome, and each time the pet is negatively reinforced by removal of the stimulus. The different presentations of aggression, including stranger directed, owner directed, aggression to strangers, owners, unfamiliar dogs, family dogs and pain induced, which may have different underlying mechanisms.^{1,2} In a recent study of veterinary behaviour cases, owner directed aggression was the most frequent complaint (39%) and aggression to unfamiliar people (22%) with 1.4 diagnoses per pet.²

Prognosis

Prognosis is about both safety and the potential for improvement. The ESVCE position statement on risk management (esvce.org) describes the following steps; identify risk factors, determining who might be harmed and how, discuss precautions for each risk, record and implement, and update and review

The initial focus must be on safe management and prevention of further aggression. It is essential to insure that owners have realistic goals as to what can be achieved and how this can be accomplished. Rehoming or euthanasia may be necessary if owners are unwilling or unable to implement safety strategies or accept the limitations of what might be achieved.

Family and environmental factors including presence of children, mentally or physically challenged, understanding and commitment and the limitations of the household are critical factors in assessing risk and in determining prognosis. Unpredictability, dogs that bite in response to benign stimuli, dogs greater than 18 kg and dogs aggressive to family members are risk factors for rehoming or euthanasia.⁶ Source of dogs, age of acquisition, age of onset, breed, early environment, and medical health all influence the development of aggression and whether it can be effectively managed and treated. Unpleasant experiences by the owner (emotional state, actions) or the stimulus (threat, aggression, fear) will condition further fear. Successful removal of the stimulus with aggression or removing the pet when aggressive (although necessary for safety) negatively reinforces the behaviour.

Predictability: The most critical issue is to identify each stimulus (trigger) and situation in which aggression may arise to implement safe preventive strategies. Unpredictability is a risk factor for euthanasia.³

The bite: Dogs that threaten before biting, inhibit their bite or try to avoid, have a better prognosis provided the owner can recognise dog signalling and identify each situation in which the dog might bite. Dogs that bite intensely in response to benign stimuli are at greater risk.³ Bite scales may help to evaluate severity. <http://avsabonline.org/blog/view/ladder-of-aggression>

Learning: Aggression that is longstanding may be more resistant to change, in part because of repeated conditioning and learning. When aggression results in successful removal of the stimulus, the behaviour is negatively reinforced. In addition removal of the pet from the situation during the aggressive display, (although necessary) negatively reinforces the behaviour. Unpleasant experiences condition further fear including a) the owner's emotional response (fear, anxiety), b) actions (confrontation, punishment) or aggression, and c) fear or threats (real or perceived) from the stimulus.

Environment: Does the environment provide practical options for preventing access to aggression evoking stimuli and making graduated improvements?

Family limitations: When children are at risk the prognosis is more guarded since they are more vulnerable; more unpredictable, and less able to recognise and react to dog signalling. If there is a history of child aggression in the home, keeping the dog may not be advisable. However, 66% of dogs had never previously bitten a child and 19% never bitten an adult. Familiar children are most frequently bitten during resource guarding or engaging in petting or hugging especially when they initiate approach. Unfamiliar children are most often bitten on or in the vicinity of the property whether or not they interact.⁴ In addition, the prognosis / risk is greater when there are people in the home who are unable to interact appropriately and recognize signalling due to mental or physical disabilities.

Dog / signalment / breed: Dogs aggressive to family members are at greater risk for euthanasia if greater than 18 kg.³ Male dogs appear to be over-represented.² Age of onset may also be a risk factor. Food guarding, fear and anxiety in dogs 2 to 4 months of age is predictive of adult fear and aggression.^{5,6} Studies have demonstrated breed differences; Golden Retrievers were at lower risk for aggression, guarding breeds at a greater risk for stranger related aggression, and some breeds showing greater propensity for owner directed aggression⁷ In the English Cocker and English Springer Spaniel, aggression with impulsivity was associated with altered serotonin or its metabolites indicating a likely genetic propensity.^{8,9} There may also be a link between coat colour and aggression in blonde cocker spaniels.⁸ Since breeds have been selected for a variety of functions associated with aggression including guarding, herding, and hunting, breed differences should not be surprising. However, it is not the breed but rather the individuals within a breed that display aggression consistent with breed function.

Background / Source: Dogs obtained from pet stores, puppies raised in non-domestic environments, and a lack of urban experience from 3 to 6 months of age increases risk of aggression.¹⁰ Studies have also demonstrated that breeding for conformation may be associated with greater social fear and greater aggression to family members than working bred dogs.^{8,9}

Medical and behavioural pathology: Animals with chronic or recurrent illness may be difficult to manage. A history of a pruritic skin disorder or steroid use has been associated with aggression.⁵ In another study, medical conditions were suspected in 50% of dogs with aggression to children.⁴ Aggression that is behaviourally pathological may have a guarded prognosis, pending response to medication.

Compliance: The family's expectations, commitment, and ability to comply are a major factor in whether the dog can be safely kept in the home. Some families are unwilling or unable to

manage the risk, while others have unrealistic goals for a quick fix or greater improvement than is practical.

Safety and Management strategies

Strategies for effective and safe management include preventing access to the stimulus, identifying and avoiding triggers, understanding canine communication, and physical management devices.

1. Stimulus avoidance: Each stimulus and situation that might incite aggression must be identified to implement strategies to prevent, avoid, move the dog far enough away or redirect the dog into desirable outcomes. Each recurrence is not only a safety issue but also a learning experience that will further reinforce or aggravate the problem. In addition, identifying every stimulus and how it can be effectively muted or minimized and graded for exposure is essential for behaviour modification (desensitization and counterconditioning).
 - i) Physical separation will insure that the pet cannot see, hear, or access the stimulus (person, animal) and the stimulus cannot access the pet.
 - ii) Dogs that are aggressive with visitors to the home should be confined when visitors arrive. This could be to a separate room, a crate or pen, in the yard, or with a tie down but ideally should be the dog's safe haven. "A safe haven is an area where the animal is in control and which has become a conditioned place of safety outside of times when there are significant stressors. Consequently, when the animal is faced with potential stressors it can retreat to this place and feel relatively safe."¹¹ Alternately the dog might be kept leashed under control of an adult family member at sufficient distance (sub-threshold) from the stranger. If the triggers are specific individuals (e.g. children), times, or places, then avoidance strategies would primarily be necessary to these stimuli.
 - iii) When dogs are aggressive on walks, stimuli can be avoided by limiting walks to places and at times where stimuli can be avoided or by keeping the dog on property with alternative forms of enrichment (yard play, food manipulation toys, nose work). Alternately it might be possible to maintain sufficient distance from the stimuli, or to move far enough away for the dog to settle, should signs begin to emerge.
 - iv) Any type of approach, handling, or contact that might incite fear, anxiety or aggression should be avoided. Dogs that become aggressive when resting or in possession of food should be confined at these times (safe haven). Dogs that are protective of other resources (e.g. toys, garbage, stolen items) should be housed away from these resources or muzzled at any time they cannot be effectively supervised (with leash control if necessary). Offering a highly valued resource might be sufficiently enticing for the pet to give up a resource or leave a resting area.
 - v) For any interaction or procedure that cannot be avoided, the dog should be managed with leash and head halter, muzzle or under sedation.
2. Owner responses: Owners must cease all actions and interactions that might incite fear or aggression. Confrontation, corrective, and punitive techniques are counterproductive and will increase fear and uncertainty. Punishment may also suppress the threats that precede aggression or might cause a passive dog to become offensive. In addition when people are fearful or angry, the dog's anxiety is likely to be heightened.

3. Reading body language (See resources below): Owners should have a sound understanding of canine communication and signalling to be able to recognise facial, body and tail positions of fear, anxiety or conflict as it first begins to arise.
4. Behaviour management products: A leash and head halter that controls the muzzle can be used to refocus the dog's attention or reorient the dog away from stimuli that might incite aggression, prompt desirable outcomes (e.g. sit, back up, walk away) and close the mouth in an emergency situation. Alternately a leash and front control harness can provide added control to calmly and effectively move the dog away from potential problems. Visual and auditory stimuli might be muted using eye or ear covers, music, or white noise. A basket muzzle provides safety and a means of calmly managing the situation. When using any of these products care should be taken to condition a positive association before using for training and exposure. A Treat and Train provides an additional option for immediately rewarding and shaping desirable outcomes at a location such as on a bed or mat.
5. Drug therapy and natural supplements might be indicated for reducing fear, anxiety, impulsivity or reactivity and control underlying behavioural pathology.

Foundation exercises: Training should focus on teaching those behaviours that will be required to manage and improve problems, beginning in environments where successful outcomes can be achieved, safety can be insured and fear evoking stimuli avoided. Highest value rewards should be used to train and shape progressively more calm / settled responses. Indoor training should include sit/watch, down/settle, go to a mat or crate, and perhaps give/drop, leave it and come (depending on the problem). For problems on walks, training should include sit / watch, loose leash walks, and turning to walk away or backing up. These cues might then be used for successful and positive control for desensitization and counterconditioning and response substitution in the presence of the stimuli (See notes on treatment of fear aggression).

Body language and safety

Dr. Sophia Yin: drsophiayin.com, drsophiayin.com/resources/video_full/dog-bite-prevention-psa-why-dogs-bite-and-what-to-avoid

Learn to speak dogs and teach your kids: doggonessafe.com

Modern Dog Magazine: <http://www.moderndogmagazine.com/articles/how-read-your-dogs-body-language/415>

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Zoom Room Guide to Body Language: [youtube.com/watch?v=00_9JPtXHI](https://www.youtube.com/watch?v=00_9JPtXHI)

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CANINE FEAR AGGRESSION TREATMENT – MEETING PEOPLE AND DOGS

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Aggression directed toward unfamiliar pets or people is predominantly a problem of fear and/or anxiety. In addition, when aggression is limited to, or is more intense on the home territory, there may be a territorial component. A correlation has been found between aggression to unfamiliar people and dogs that were raised in non-domestic environments (e.g. kennel, garage, barn), and a lack of experience with urban environments between 3 and 6 months; however, no association was found between environment, urban experience and aggression to other dogs.¹ Aggression may be due to medical or behavioural health issues such as impulsivity with alterations in serotonin in English Cocker and Springer Spaniels.^{2,3} In addition dogs on a leash are reported to be twice as likely to threaten and bite.⁴ This may be due to an inability to escape or control access to stimuli, restricted opportunity for normal communication, owner influence, and previous experience. Treatment requires safe and effective management of the problem with preventive measures; training to achieve focused and calm behaviours in the absence of any stimuli; teaching cues that communicate to the pet to focus and relax; management products; drugs or natural products where indicated and graduated exposure training (desensitization and counterconditioning and response substitution).

Diagnosis

Underlying medical problems that might cause or contribute to the signs must first be ruled out or (e.g. neurologic disease, endocrine disorders, metabolic disease, pain). The diagnosis, prognosis (risk assessment) and treatment plan, will then be determined from the history, evaluation of the pet and viewing any movie clips the client can provide.

Prognosis

Prognosis is about both safety and the potential for improvement. (See esvce.org for position statement on risk management). In one study of dogs that were aggressive toward unfamiliar dogs, 76% could be around other dogs on leash outdoors after treatment.⁵

The initial focus must be on safe management and prevention of further aggression. It is essential to insure that owners have realistic goals as to what can be achieved and how this can be accomplished. Rehoming or euthanasia may be necessary if owners are unwilling or unable to implement safety strategies or accept the limitations of what might be achieved.

Safety and Management strategies

Strategies for effective and safe management include preventing access to the stimulus, identifying and avoiding triggers, understanding canine communication, and physical management devices.

a) Stimulus avoidance: Each stimulus and situation that might incite aggression must be identified so that it can be prevented or avoided. For dogs with aggression outdoors / on walks, stimulus avoidance can be achieved by avoiding dog parks or specific locations, avoiding walks, walking the dog when and where stimuli can be avoided or insuring that sufficient distance from stimuli can be insured. Physical products including leash and head halter, leash and front control harness or with muzzle attached can help to insure safety. When dogs are aggressive to visitors coming to the home, the dog can be confined to or tethered in a location where it can be safely

and comfortably housed, or kept on leash under the control of one of the owners. If specific stimuli, times, or locations can be identified (children, visitors, food bowl, dog park) only those might need to be avoided.

b) Owner responses: Owners must be aware of how their actions and interactions influence behaviour. Confrontation, corrective and punitive techniques, or attempts to control through dominance are counterproductive and may increase fear and aggression.^{7,8} In addition when owners are fearful anxious, the dog's anxiety is likely to be heightened.

c) Products, drugs and supplements might include i) a safe haven / secure confinement, ii) leash and head halter or leash and body control harness (not prong, choke, shock), iii) basket muzzle, iv) products that mute visual and auditory stimuli such as eye or ear covers, cage covers, music or white noise and v) drug therapy and supplements

Reading body language

Owners must know when and where aggression might arise, and have a clear understanding of canine communication to be able to recognise facial, body and tail positions of fear, anxiety or conflict as it first begins to arise including tense, raise hackles, ears flattened, licking lips, yawning, and panting. This is essential for safety and prevention, to effectively address pet welfare, and to understand the threshold / limits for safe and effective exposure training (response substitution, desensitization and counterconditioning). See resources below.

Structure and consistency

All interactions should be structured and predictable. Before giving anything of value the dog should be consistently taught to sit calmly (say please by sitting, structured interaction training, learn to earn, nothing in life is free, no free lunch). The dog should be taught to sit or lie down calmly before getting anything of value, most specifically when seeking attention or affection but also before play (throwing a toy for fetch, nose work), putting on and taking off leash, going out the door for walks, meeting and greeting and giving food or treats. Gradually shape calmer and more focused behaviours. Consistent and predictable interactions remove anxiety, uncertainty and arousal, by using rewards solely as a reinforcement for desirable behaviour, and giving the dog control of its resources by sitting calmly. See handouts and videos at drsophiayin.com

Foundation Training

a) During the preventive program, the owner should teach the foundation behaviours needed for achieving the desired outcomes during future exposure. Behavioural guidance should focus only understanding and learning how to implement positive methods of behaviour modification with resource material and the support of a force free trainer. The guiding principle should be "reward what you want and ignore or prevent what you don't want." Confrontation, corrective, and punitive techniques or approaches that are intended to control through dominance are counterproductive and might further compound fear and aggression.^{7,8} Products that might be utilized to help insure safety (e.g. muzzle) and better achieve training goals (e.g. head halter) should be gradually and positively introduced in advance of the exposure training. In addition, any drugs or natural products to control underlying pathology and reduce anxiety and reactivity should be administered to achieve optimal therapeutic effect in advance of exposure training.

b) For foundation training, the dog will first need to be taught the behavioural responses that will be used to calm the dog in the presence of unfamiliar dogs and people including sit/watch, loose leash walk, backing up, turning away, and going to a mat or bed on cue (safe haven).

Come or leave it, down/settle, and drop/give might also be appropriate. Target training, clicker training, and the use of a leash and head halter or leash and body control harness can be useful management aids. Highest value rewards and clicker training should be used to shape gradually longer and more relaxed responses (body postures, breathing).

c) Training should begin in situations and locations where the pet is calm and focused, using valued rewards to achieve desirable outcomes before gradually progressing to other environments with increasing distractions. The owner can then focus on training the dog to calm in the presence of familiar people or dogs as it begins to become aroused or excited. The use of a leash and head halter can help to provide physical control and safety for maintaining focus or turning the pet away when potentially problematic situations arise.

Exposure Training

1. Once foundation exercises are reliably trained, drugs and/or natural products have reached efficacy and the situations in which problems might arise have been successfully managed, the owners might proceed to controlled exposure training. A gradient of stimulus intensity, reward gradient, desensitization and counterconditioning, and response substitution should be reviewed. Most owners will benefit from the oversight and guidance of a reward based trainer or behavioural technician for recognizing canine communication signalling, identifying the behaviour threshold and implementing the exposure program.

2. Stimulus exposure: The goal is to get calm and positive outcomes during stimulus exposure while working at or below the threshold at which the dog exhibits anxiety. Training should begin at or below the threshold at which the dog exhibits anxiety. Exposure should be set up (set up to succeed) by controlling all parameters (stimulus, dog, environment) and associating favoured reward with each exposure to the stimulus. Desensitization and counterconditioning is achieved by repeatedly exposing the dog to stimuli at level below the threshold and pairing with high valued rewards to make a positive association. Calming the dog with commands, “attitude” and the aid of a device for additional control if appropriate, is response substitution.

3. Stimulus gradient: Controlling the stimulus and introducing it in a graduated manner can be a challenge to implement. Stimuli might be visual, auditory, olfactory, or tactile. Stimuli can be controlled in intensity by a) distance, b) location c) stimulus characteristics (e.g. uniform, height, age, sex, breed, etc.) d) activity (e.g. motion, volume) and e) by exposing to individual components of the fear evoking situation one at a time. Video or TV images might also be a starting point.

Outdoors the stimulus could approach slowly while maintaining an acceptable distance or walk past slowly and calmly parallel to the dog. Indoors the dog can be brought out from confinement to maintain a distance where it can be successfully calmed and rewarded (response substitution) or high value rewards paired with each exposure (countercondition).

With further exposure the stimulus can move closer, increase movement, or volume intensity or activity. Throughout the training owners must be observant of any signs of fear or anxiety to be able to stop the exposure and reduce the intensity of the stimulus (or remove the pet) to end on a calm, positive outcome.

Drugs and Supplements

See notes on drug therapy for aggression in dogs.

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Resources

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2. Web resources: www.drSophiaYin.com, www.clickertraining.com
3. Canine communication and body language:
 - DVM NewsMagazine – Watching and labelling interactions
<http://veterinarynews.dvm360.com/do-dogs-appease-each-other-or-us-veterinary-research-focuses-watching-and-labeling-canine-interactions>
 - Learn to speak dog and teach your kids: doggonessafe.com
 - Modern Dog Magazine - How to Read Body Language -
<http://www.moderndogmagazine.com/articles/how-read-your-dogs-body-language/415>
 - Yin S. Online movie clip and poster - http://drsophiayin.com/resources/video_full/dog-bite-prevention-psa-why-dogs-bite-and-what-to-avoid
 - Zoom Room Guide to Body Language: https://www.youtube.com/watch?v=00_9JPltXHI

CANINE AGGRESSION: DRUGS AND SUPPLEMENTS

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When the dog is excessively aroused, fearful, anxious, overly reactive lacking impulse control or “behaviourally abnormal”, psychotropic medications are indicated to improve the problem as well as address the dog’s well-being. However, drugs do not change the relationship with the stimulus; therefore, concurrent behavior modification is needed to desensitize, countercondition and train desirable.

Selective serotonin reuptake inhibitors might be most effective for hyperactivity, aggression, social anxiety, generalized fear and anxiety and panic disorders. Four weeks or longer is generally required to achieve full therapeutic effects. Starting the medication at the time of the consultation allows time for the drug to reach optimal therapeutic effect when the exposure program begins. Medication might not be required for dogs that can be effectively kept away from fear- evoking situations, provided the dog is sufficiently settled and relaxed. Adjunctive medication to further reduce anxiety especially prior to stimulus exposure might include benzodiazepines, trazodone, clonidine or propranolol, alone or in combination. If effective these drugs might be used several times a day.

Evidence and drug selection

Evidence based decision making allows treatment options to be selected using the available evidence together with the needs of the patient, client and problem. To date there are no randomized placebo controlled trials (RCT) for medications for the treatment of aggression in dogs. Yet in veterinary behaviour the placebo effect can reach 50% or higher.¹ Laboratory models also provide a standardized measure for evaluating therapeutic effect with minimal subject variability and no owner bias.² In veterinary behaviour drug information is often extrapolated from human literature; however, metabolism and effects vary between species and individuals. For example the clearance $\frac{1}{2}$ life of diazepam and its active intermediate metabolite nordiazepam in dogs is 2.5-3 hours and in humans up to 48 hours for diazepam and 100 for nordiazepam. When dose, compliance or availability is an issue compounding is an option; however, stability, storage and bio-availability are concerns.

Psychotropic drugs

Selective serotonin reuptake inhibitors (SSRI) are most commonly used in dogs that are behaviourally abnormal, to control reactivity and impulsivity, reduce fear and anxiety and improve trainability as well as address the dog’s behavioral well-being. SSRI’s are selective in blocking the reuptake of 5HT1A into the presynaptic neurons. Fluoxetine and paroxetine might be useful for general anxiety disorders, stabilizing mood, reducing impulsivity and behaviorally pathologic aggression. Fluoxetine and fluvoxamine might be effective for hyperactivity and aggression; paroxetine for social anxiety and panic disorders; and sertraline may be effective for irritable aggression, generalized fear and anxiety and social aggression.

The primary mechanism of action of TCA’s is to block the reuptake of serotonin and to a lesser extent noradrenaline. They also have anticholinergic and antihistaminic effects which may contribute to varying levels of sedation, urine and stool retention. Clomipramine and

amitriptyline may be useful in controlling underlying anxiety and impulsivity in aggressive dogs. However, studies have shown no effect of amitriptyline or clomipramine on canine aggression.^{3,4}

While antidepressants reach peak plasma levels within hours, reuptake inhibition may induce down-regulation of postsynaptic receptors that are responsible for clinical effects. Therefore, 4 weeks or longer is generally recommended to fully assess therapeutic effects. Starting the medication at the time of the consultation allows time for the drug to reach optimal therapeutic effect when the exposure program begins. There is extensive evidence for the use of clomipramine and fluoxetine for treating generalized anxiety and compulsive disorders and case evidence for the use of SSRI's for social phobias.

Buspirone is a serotonin (5HT_{1A}) receptor agonist and a dopamine (D₂) agonist. It is used for mild fear and anxiety. It is non-sedating, does not stimulate appetite, and does not inhibit memory. It takes a week or more to reach effect. Adding buspirone to an SSRI might help to insure an adequate serotonin pool.

Benzodiazepines potentiate the effects of (GABA), an inhibitory neurotransmitter. They cause a decrease in anxiety, hyperphagia, and muscle relaxation. They have a rapid onset and may have a rebound effect on withdrawal. They can be used alone or adjunctively primarily on an as needed basis but may be considered in select cases on an ongoing basis with multiple daily dosing.^{5,6} They may cause paradoxical excitability, increased activity, and an amnesic effect. They might be useful for drug desensitization and counterconditioning. Buspirone and benzodiazepines can disinhibit which may result in aggression.

Beta blockers such as propranolol reduce physiologic signs of anxiety (heart rate, respiratory rate, trembling). Therefore they might be most useful if combined with drugs that reduce behavioural anxiety.⁵ Clonidine a selective alpha-2 agonist that blocks noradrenaline, might be used together with SSRI's for situational use in fear or territorial aggression, separation anxiety, nocturnal barking, or noise phobias.⁷

Trazodone, a serotonin 2A antagonist-reuptake inhibitor, may be useful in dogs for generalized anxiety, separation anxiety, storm phobias, and some forms of aggression including interdog aggression and impulse control disorders. Trazodone can be used on as needed basis alone or in conjunction with a TCA or SSRI or 2 to 3 times daily.⁸

Focal seizures of the temporal lobe may present with mood alterations or hallucinatory and self-traumatic behaviours. Generalized seizures may be associated with aggression e.g. in the post-ictal phase. Therefore anticonvulsants may be a consideration in diagnosis and treatment. Levetiracetam may be effective for focal seizures, and for anxiety, panic, and mood disorders which may have comorbidity with epilepsy. Gabapentin might be combined with SSRI's for the treatment of impulse control disorders, noise phobias and to reduce reactivity. Carbamazepine is also a mood stabilizer that may be a useful adjunct to SSRI's for irritable and impulsive aggression.

Neuroleptics decrease motor function at the level of the basal ganglia in the brain, elevate prolactin levels and may reduce aggression as dopamine antagonists. Phenothiazines such as acepromazine are sedatives but do not reduce anxiety.

Selegiline is an MAOB inhibitor licensed for CDS in North America, and emotional disorders in Europe. Chronic stress associated with stereotypic and displacement behaviours, fear aggression, and autonomic signs, may have elevated prolactin levels, which might improve with selegiline, while lower prolactin levels are seen with acute onset fears and phobias which might improve with fluoxetine therapy.⁹

Complementary and alternative medications (CAM's) are another option; however, few have been assessed in evidence based studies. Yet these products have appeal because they are considered "natural", are available OTC and have extensive anecdotal support. Products that might be useful in reducing anxiety and improving trainability include Adaptil, alpha-casozepine, l-theanine, melatonin, Harmonase and aromatherapy. Each of these might be used concurrently with drug therapy. Aggression might be reduced by supplementing tryptophan to a reduced protein diet (to optimize entry through the blood brain barrier). In addition, adding tryptophan to an SSRI or TCA may increase the available serotonin pool. Royal Canin Calm diet contains both alpha-casozepine and l-tryptophan. There have been no studies to demonstrate efficacy of other natural products including Bach flower remedies or homeopathy.

Abnormal aggressive dogs

For most cases of behaviourally abnormal dogs an SSRI such as fluoxetine or paroxetine would be the first choice for managing underlying anxiety and impulsivity. Immediate acting medications might be needed concurrently prior to specific events including benzodiazepines (e.g. alprazolam, lorazepam, diazepam), trazodone, clonidine, or propranolol. Natural products might also be used concurrently. In some cases drug combinations will need to be considered such as a combination of SSRI with carbamazepine, gabapentin, clonidine, trazodone, buspirone or even a TCA (with cautious monitoring for serotonin syndrome).

Drug doses for behaviour therapy

	Dose
Alprazolam	0.02-0.1 mg/kg bid to qid
Clonazepam	0.1-1.0 mg/kg bid to prn
Diazepam	0.5-2 mg/kg prn to q6h
Lorazepam	0.25-0.2 mg/kg sid to prn
Amitriptyline	2.0-4.0mg/kg bid
Clomipramine	1-3 mg/kg bid
Citalopram	0.5-2.0 mg/kg sid
Fluoxetine	1.0 – 2.0 mg/kg sid
Fluvoxamine	1.0 -2.0 mg/kg sid – bid
Paroxetine	0.5-2.0 mg/kg sid
Sertraline	1-5 mg/kg sid or divided bid
Clonidine	0.01-0.05mg/kg prn to tid
Propranolol	0.5-3.0 mg/kg bid or prn
Buspirone	0.5-2.0 mg/kg sid-tid

Trazodone	2 to 8 mg/kg prn to tid (up to 15 mg/kg prn)
Gabapentin	10-30 mg/kg bid to tid
Carbamazepine	4-8 mg/kg bid to tid
Levetiracetam	20 mg/kg tid
Selegiline	0.5-1 mg/kg sid in am

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COGNITIVE DYSFUNCTION SYNDROME – DO PETS GET ALZHEIMERS?

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Cognitive dysfunction syndrome (CDS) is a neurodegenerative disorder of senior dogs and cats which is characterized by a gradual cognitive decline and increasing brain pathology. The diagnosis is based on clinical signs described by the acronym DISHA; **D**isorientation; altered social **I**nteractions c) altered **S**leep-wake cycles d) **H**ousesoiling and e) **A**ltered activity levels. An increase in anxiety is also reported.^{1,2}

While the decline in learning and memory may be the most important indicator of cognitive decline, the average pet may appear minimally challenged. Therefore the development and validation of tests for assessing cognitive function in the laboratory (e.g. spatial memory, attention, discrimination, reversal) has been instrumental in identifying age related deficits in learning and memory.^{1,3-5} In fact, dogs and cats may show impairment as early as 6 to 8 years of age. Although impractical for clinical use, similar tasks have been developed that also demonstrate deficits in pet dogs including DNMP and an open field food search. From a clinical perspective, a decrease in performance of previously learned commands, learned behaviors, breed specific activities (retrieve, hunt) or a decline in ability to learn new tasks might be seen.

PREVALENCE

Not all dogs and cats will develop CDS. Prevalence of cognitive impairment from 22.5% to 74% has been reported.^{6,7} In one recent study by Salvin et al., prevalence of CDS in dogs ranged from 5% in dogs 10-12 to 41% in dogs over 14 with an overall prevalence of 14.2%.¹² In a cat study, 35% had signs consistent with CDS; 28% of 95 cats aged 11 to 15 and 50% of 46 cats over 15.⁸

Both prevalence and severity increase with age. In one study of 215 dogs over 6 months 42% of dogs with no impairment progressed to mild impairment and 24% from mild to moderate impairment. This rose to 71.4% converting from none to mild and 50% from mild to moderate after 1 year.⁶ Another study of 94 dogs over 8 years of age found that 58% of dogs with no signs of CDS progressed to borderline cognitive dysfunction, and 11% of dogs moved from borderline to CDS.² In both studies dogs with no impairment did not progress to dementia.

BEHAVIOR SIGNS IN SENIOR PETS

a) Owner reported signs

The prevalence of behavioral signs in senior pets will vary with the caseload. For example the most commonly reported signs in senior pets at behavior referral practices reflect those that are sufficiently problematic to the pet or the owner to seek help. While CDS may be an underlying factor, other neurologic diseases, sensory decline, endocrine and metabolic disorders, musculoskeletal disease and other causes of pain must be ruled out.

In one study of 270 dogs over 7 years of age presented for behavior problems, 32% displayed aggression to family members, 16% aggression to family dogs, 9% barking, 8% separation anxiety, 6.4% disorientation, 6% aggression towards unfamiliar people, 5% housesoiling, 4.2% destructive, 4% compulsive disorders and 3% noise fears.⁸ Of 83 cats referred for behavioral consultations most cats

presented with marking or soiling (73%), followed by aggression (16%), vocalization (6%) and restlessness (6%).¹

b) Cognitive decline and dysfunction

As signs of cognitive decline may initially be subtle and pet owners unaware that treatment options are available, many cases go unreported until the signs become problematic for the owners, or a welfare issue for the pet. However, early detection allows for early intervention so that further decline might be slowed and behavioral signs improved. In one survey owners reported only 12% of pets with signs, while in the Salvin study, 85% of cases had not been diagnosed.⁷ Therefore veterinarians must be proactive in questioning owners as to the presence of signs. Of 957 dogs 8 years and older, when compared to their behavior 6 months previously, more than half of the behaviors showed a greater incidence of deterioration and two thirds showed a significant age related deterioration in severity. Activity and play levels, response to commands, and fears and phobias deteriorated most, although medical causes may have been an underlying cause.¹⁰ In a second study of 94 dogs over 8 years of age, that had been thoroughly screened to rule out medical problems, the most common signs of CDS were sleeping more during the day and restless at night (57%), altered social interactions (51%), disorientation (49%) and anxiety (46%).² For dogs with mild cognitive dysfunction, the predominant sign was daytime sleep (70%) with anxiety in 11% of dogs while anxiety in the non-cognitive dysfunction dogs was 4%. The most commonly reported sign in cats 11-14 was altered social interactions while for cats 15 and over, alterations in activity including aimless activity and vocalization were most common.^{8,3}

DIAGNOSIS OF CDS

When signs of CDS are identified, a diagnostic workup is necessary to rule out medical, physical and motor dysfunction as a cause of the signs. What needs to be assessed and with what diagnostic tools must be based on the behavioral and medical presenting signs, physical examination, and results of baseline screening. Next to neurological disease, sensory decline, endocrine and metabolic disorders and musculoskeletal disease are the primary rule-outs.

AGING AND ITS EFFECT ON THE BRAIN

In dogs, with increasing age frontal lobe volume decreases, ventricular size increases and there is meningeal calcification, demyelination, a reduction in neurons and an increase in toxic free radicals.^{5,11} In cats, there is also neuron loss, increased ventricular size, cerebral atrophy and widening of sulci although not as marked as dogs.⁸ Circulatory changes in dogs and cats including microhemorrhage and infarcts may also be responsible for signs of CDS. A decline in the cholinergic system has also been identified which may contribute to declining cognitive and motor function.¹² In dogs, cats and humans there is an accumulation of diffuse beta amyloid plaques and perivascular infiltrates^{11,13,14} Increased A β is positively correlated with cognitive impairment in dogs but results in cats are variable and numbers are low.^{8,14} The most striking difference from humans is the absence of neurofibrillary tangles in dogs and cats although hyperphosphorylated tau is reported. Most recently cognitive decline has been shown to be related to neuroinflammation and tau hyperphosphorylation in synapses in dogs.¹⁵

ENVIRONMENTAL MANAGEMENT AND COGNITIVE ENRICHMENT

When cognition is impaired, diet, drugs or supplements might be useful in improving signs and slowing the progress of CDS. Canine studies have demonstrated that mental stimulation in the form of training, play, exercise and manipulation toys can help to maintain quality of life as well as cognitive function.¹⁵

MEDICAL THERAPY

Selegiline is an inhibitor of monoamine oxidase B in the dog which has demonstrated efficacy in improving cognitive signs. It has been shown to increase 2-phenylethylamine in the dog brain, a neuromodulator that enhances dopamine and other catecholamines in the cortex and hippocampus. It may also contribute to a decrease in free radical load through decreased production and increased clearance. Dose is 0.5 – 1.0 mg/kg daily.

Since the elderly are particularly susceptible to the effects of anticholinergic drugs, it is prudent to avoid drugs with anticholinergic effects.¹⁶ In fact, drugs or natural products that enhance cholinergic transmission might have potential benefits for improving signs of CDS in dogs and cats.¹² Propentofylline, a xanthine derivative is licensed for lethargy and depressed demeanour in old dogs in some countries but not in North America. It may increase blood flow and inhibit platelet aggregation and thrombus formation. Other treatment strategies include nicergoline an alpha 1 and alpha 2 agonist and the NMDA antagonist memantine. No drugs are approved for cats; however, selegiline and propentofylline may be useful. .

A primary therapeutic strategy for cognitive dysfunction in dogs, cats and humans is to reduce the risk factors that contribute to cognitive decline. It is likely that an integrative approach is required such as a diet fortified with antioxidants and polyunsaturated fatty acids. In dogs, a senior diet (Canine b/d, Hills Pet Nutrition) has been shown to improve signs and slow the progress of cognitive decline. It is supplemented with fatty acids, antioxidants (vitamins C and E, beta carotene, selenium, flavonoids, carotenoids), and dl-alpha-lipoic diet and l-carnitine to enhance mitochondrial function.^{16,17} The combined effect of the diet plus an enriched environment provided the greatest improvement.¹⁶ However, while enrichment resulted in improvement in cognitive function, the dietary therapy resulted in a reduction in reactive oxygen species and in beta-amyloid accumulation.¹⁷

A Purina Veterinary Diet (Essential Care Senior, Pro Plan Bright Minds), supplemented with botanic oils containing medium chain triglycerides to provide ketone bodies as an alternate source of energy for aging neurons, has also been shown to significantly improve CDS in dogs.¹⁸ For cats, a diet (not yet commercially available) developed by Nestle Purina supplemented with antioxidants (Vitamins E and C and Selenium), arginine, B vitamins and fish improved learning and memory tasks compared to a control diet in cats 5.5-8.7 years.³

Senilife® (CEVA Animal Health), has demonstrated efficacy in improving cognition in both a laboratory model and clinical studies in dogs. It contains phosphatidylserine, a membrane phospholipid as well as Gingko biloba, vitamins E and B6 and resveratrol. Another product with phosphatidylserine, omega-3 fatty acids, vitamins E and C, l-carnitine, alpha-lipoic acid, coenzyme Q and selenium is available in the UK. The cat product has no alpha-lipoic acid.

S-adenosyl-l-methionine (Novifit®, Virbac) may help to maintain cell membrane fluidity and receptor function, regulate neurotransmitter levels and increase production of glutathione. Improvement has been demonstrated in dogs in a placebo controlled trial and in laboratory studies in both dogs and cats.

Apoaequorin (Neutricks™) is a protein found in jellyfish that in laboratory trials improved learning and attention in dogs. It is a calcium buffering protein that may provide neuroprotection against aging.

BEHAVIOR MODIFICATION AND ADJUNCTIVE MEDICATIONS

Together with the treatment for CDS, psychotropic medications may be required to manage underlying stress and address those signs such as night waking, agitation and anxiety that continue to be problematic for the owner and pet. In addition, clinical signs may persist even if CDS and underlying anxiety and stress have been effectively addressed. Therefore concurrent environmental management and behavior modification are also likely to be needed.

Since anticholinergic drugs should be avoided, SSRI's or buspirone might be preferred options for ongoing use. Trazodone might also be considered either alone or in combination with an ongoing SSRI or buspirone. However, drugs that increase serotonin, should not be used concurrently with selegiline. While benzodiazepines could contribute to further cognitive deficits, they may be useful in managing signs of anxiety and sleep disturbances. Lorazepam, clonazepam, and oxazepam are preferred since they have no active intermediate metabolites. Adjunctive use of propranolol or clonidine may reduce some of the noradrenergic effects contributing to the signs of anxiety. Gabapentin might reduce reactivity and neuropathic pain. Natural products might also aid in the control of anxiety.

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