Behavioural Changes In Ageing Dogs: A Demographic Analysis

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Thanks to improvements in medical care, dogs are living longer and are at risk of developing age-related behavioural disorders. Veterinary practitioners have long been aware of the occurrence of geriatric behavioural changes in pet dogs such as reduced responsiveness in greeting their caretakers, disorientation in the home or garden, disturbance of normal sleep-wake cycles and housesoiling. These behavioural changes can sometimes be associated with histologic lesions in the brains of affected dogs. Many of the specific behavioural signs of senility in dogs are generally related to deficiencies in memory and learning, manifested as becoming lost in the home or garden, staring into space and not recognising family members. Other signs of behavioural senility are reduced or interrupted sleeping at night, increased sleeping in the day, reduced general activity, reduced social interaction with human members of the family and housesoiling with loss of signalling to go outside. These behavioural signs have been compared to Alzheimer's disease in humans where the cognitive deficits typically include signs of memory impairment, language disturbance, impaired ability to carry out motor tasks, failure to recognise familiar objects, and decreased ability to plan (Wisniewski et al., 1990; Suzuki et al., 1978). Because the histologic lesions are similar to those observed at autopsy in people with dementia of the Alzheimer's type, it has been suggested that dogs may be used as models for research on human Alzheimer's disease (Cummings et al., 1996; Ruehl et al., 1995). Microscopic changes in the cerebral cortex of dogs, particularly extensive beta-amyloid deposition within neurones and their synaptic fields (giving rise to senile plaques), while not identical with the microscopic changes seen in the brains of deceased human Alzheimer's patients, are correlated with degrees of memory impairment.

In this report, we focus especially on abnormalities in behaviours that were previously normally displayed and which may represent decrements in cognitive behaviour as a reflection of impairments in memory and learning. As currently used in animal behaviour, cognition refers to mental processes that are occurring within animals and which cannot be directly observed, but would include memory, learning, awareness and perception (MacFarland, 1989). In dogs, behaviour which would involve spatial orientation, memory, learning, housetraining and recognising and reacting to human family members are undoubtedly external manifestations of cognition.

Method

In order to obtain a picture of the prevalence of signs of behavioural senility in dogs in the general population, a demographic study was undertaken. Data was obtained from 146 dogs aged 11-16 years in structured telephone interviews in which one of the investigators filled out a 4-page form collecting data on a variety of measures. Most questions had to do with behavioural senility; other questions were distracters or were designed to make the conversation flow more easily and reduce the tendency for the client to give "expected" answers. The subjects were previous patients of the UC Davis Veterinary Medical Teaching

Hospital assuring at least some degree of minimal veterinary care. Randomly selected medical records were stratified for appropriate age groups and to provide approximately equal numbers of castrated males and spayed females (most aged dogs are gonadectomized). A screening interview determined if the dog was still alive and not suffering from some major medical problem that might have behavioural effects. A time was arranged for an investigator to contact the client. For dogs that passed the screening interview, their owners were sent some information about possible behavioural changes associated with ageing prior to the investigator's telephone interview. During the investigator's interview, data was entered on a spreadsheet with regard to scores for 4 categories of abnormal behavioural patterns: 1) changes in the sleep-wake cycle, 2) changes in social interactions 3) complete or partial loss of housetraining and 4) disorientation. The specific criteria for scoring positive in any one category varied with the category. A positive score was given for sleep-wake cycle changes if the dog scored positive on two out of three parameters, namely waking up the owner at night, sleeping less at night and sleeping noticeably more during the day. A positive score was given for changes in social interactions if there was a noticeable increase or decrease in two of the three parameters namely, greeting owners, soliciting attention from owners and following owners around the house. Housetraining was scored positive if the dog started to urinate and/or defecate in the house with no other behavioural or medical explanation for the behaviour. Disorientation was scored positive if there was one clear indication of disorientation such as frequently staring into space, getting lost in the house or yard, getting stuck in corners or standing at the wrong door or wrong side of the door to go out. For a category to be judged positive the behavioural changes must have been observed at least once a week and for a duration of one month. Prior to beginning the study, disorientation was considered to be the abnormal sign most clearly related to an impairment of learning and memory and thus perhaps most indicative of a reduction of cognitive processing. Three levels of severity of age-related behavioural changes were established: (1) positive for at least one of the four categories; (2) positive for disorientation plus at least one other category; (3) positive for disorientation plus at least 2 other categories. A dog at the second or third level was considered to be positive for cognitive dysfunction (CD), a condition possibly analogous to human Alzheimer's disease.

Results

As might be expected, it was much easier to find subjects of the younger than the older ages so more data are available for the ages 11-14 than for 15 and 16. There was no apparent difference in the percent of male or female dogs with regard to any of the 3 levels of age-related behavioural changes, and therefore male and female subjects were combined to increase the N for the further analyses. Overall about 20 percent of dogs were positive for CD but the positive percentage increased somewhat with age. Undoubtedly, as animals show behavioural signs of senility, especially housesoiling, owners choose to have the animals euthanased, and thus if euthanasia were not performed, the percent of dogs positive for CD could increase dramatically with age. Unfortunately, there is no feasible way to address this issue. The data are consistent with the concept that like elderly people, the percent of dogs with abnormal signs of behavioural senility increases with advancing age.

Among the questions we explored with this database was the relationship between body size and prevalence of CD at any particular age. It is well known that dogs of large body size seem to age faster than dogs of smaller body size; that is, the life expectancy of large-bodied dogs is less than that of dogs of smaller body size. A question of interest is whether dogs of larger body size also develop CD at an earlier age reflecting apparent accelerated ageing of the

brain. Interestingly, the data for all age groups combined reveal virtually the same percent with CD (21-22%) among the dogs above the median in body weight (mdn 30 lbs, range 18-52) as those below the median (mdn 8.5 lbs, range 2- 18 lbs). Thus dogs that have a lower life expectancy as a function of body weight do not appear to be at greater risk to develop CD at any particular age.

Another question was the degree to which visual impairment, a fairly common occurrence in ageing dogs, is related to signs associated with disorientation. Of 49 visually impaired dogs (according to owners) ages 11-14, 39 percent had signs of disorientation and of 73 visually normal dogs of the same age range, 12 percent had signs of disorientation. While one would expect some correlation between visual impairment and disorientation, clearly dogs may be disoriented without evident visual impairment or be visually impaired without disorientation.

Finally, another analysis looked at the relationship of late-onset aggressiveness (mostly irritable) and the occurrence of CD. Overall, about 20% of older dogs showed an increase in aggressiveness; a decrease in aggressiveness was just about as likely. In contrast to younger dogs where aggression is much more likely in males than females, the emergence of aggression in elderly dogs was found to be more than twice as prevalent in females as males and a decrease in aggression more likely in males than females. Late-onset aggressiveness was 4 times more likely in dogs positive for CD than in dogs scoring negative for all behavioural categories. Thus the onset of aggressiveness in elderly dogs seems to be an aspect of behavioural senility.

Conclusion

These analyses, and future studies on ageing dogs will provide caretakers of ageing dogs and their health care advisors useful information in behaviourally and pharmacologically treating age-related behavioural problems (Ruehl and Hart, 1998).

References

Cummings, B.J., Head, E., Ruehl, W., Milgram, N.W. and Cotman, C.W. (1996). The canine as an animal model of human ageing and dementia. Neurobiol. Ageing 17:259-268.

McFarland, D (1987). The Oxford Companion to Animal Behaviour. Oxford University, Oxford.

Ruehl, W. W. and B.L. Hart (1996). Canine cognitive dysfunction: Understanding the syndrome and treatment. In Dodman, N.C. and Shuster, L (eds). Veterinary Behavioural Pharmacology. New York, Chapman and Hall (in press).

Ruehl,WW.,Bruyette,DS.,DePoali,A.,Cotman,CW.,Head,E.,Milgram,WW.,and Cummings,BJ.(1995). Canine cognitive dysfunction as a model foe age-related cognitive decline, dementia and Alzheimer's disease. Clinical presentation, cognitive testing, pathology and response to 1-diprenyl therapy. In: Tiphon,K. and Boulton,AA. (eds). Progress in brain research, pp 217-225. Elsevier, Asterdam.

Suzuki, Y.,Akiyama, K.and Suu, S. (1978). Lafora-like inclusion bodies in the nervous system of aged dogs. Acta Neuropathol. (Berl.) 44:217-222.

Wisniewski, H.M., Wegiel, J., Morys, J., Bancher, C., Soltysiak, Z. and Kim, K.S. (1990). aged dogs: an animal model to study beta-protein amyloidogenesis. *In*Mauer, K., Riederer, P. and Beckmann, H. (eds), Alzheimer's Disease, Epidemiology, Neuropathology, Neurochemistry and Clinics, pp.151-168:Springer-Verlag,NY