

Running head: EFFECTS OF METHYLPHENIDATE ON HYPERACTIVE DOGS

An Examination of the Effects of Methylphenidate on Reducing Hyperactivity in Dogs

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Abstract

Past studies have found that behavioral problems are the main reason for relinquishment of dogs to animal welfare agencies. Although hyperactivity, the most common behavioral problem, can be reduced through behavioral training, many owners do not have the time, patience, or resources to engage in this treatment. In this study, an alternative treatment for reducing hyperactivity levels among dogs, the use of the stimulant methylphenidate, is examined. According to both an objective and a subjective outcome measure, dogs taking both a standard dose and a high dose of methylphenidate had significantly lower levels of hyperactivity than those taking placebo pills during the treatment period.

An Examination of the Effects of Methylphenidate on Reducing Hyperactivity in Dogs

Approximately 15 million dogs are either turned out as strays or released to animal-welfare agencies by their owners each year in the United States (Moulton, Wright, & Ringy, 1991, as cited in Tuber, 1999). Due to the continual influx of abandoned pets, these agencies are only able to find new homes for a small percentage of homeless dogs. Thus, agencies are forced to euthanize the majority of animals that are relinquished to them. Behavior problems are a major cause of abandonment, euthanasia, and relinquishment of companion dogs to animal shelters (Patronek, 1996, as cited in Goodloe & Borchelt, 1998).

Anecdotal and unsubstantiated reports state that 50% to 70% of all euthanasias are the result of behavior problems (Spencer, 1993, as cited in Salman et al., 2000). In a study conducted by Salman et al. (2000), owners who relinquished their dogs and cats to shelters answered a series of survey questions about their reasons for relinquishing their pets. All of the undesirable behaviors (e.g., attacking animals, escaping, biting, growling at people and/or animals) that were described in the questions were reported as having occurred by many owners. Results showed that hyperactivity (53%) was the most common undesirable behavior reported by owners relinquishing dogs. Another study similarly found that a principal factor contributing to the surrender of the dog is the inability of the owner to manage its behavior. Some of the major complaints regarding the dogs' behavior include unruly or excitable behavior toward people (Patronek, 1996, as cited in Tuber, 1991).

While behavioral therapy can be effective in correcting such behavior, many owners are reluctant to dedicate the amount of time and resources needed for the therapy to work. In addition, behavioral therapy must be consistently applied in order to be effective. Thus, many dog owners are unable to succeed at behavioral therapy. The majority of dogs in shelters are

young adults exhibiting potentially resolvable behavior problems that owners were not prepared to handle (Caras, 1993; Rollin, 1991, as cited in Salman et al., 2000). Salman et al. (2000) found that of 3,676 dogs who were relinquished to shelters, 96% had not been to obedience classes, and 84.9% were not trained when obtained.

As seen from these previous studies, hyperactivity is a major problem among dogs. Past studies have shown that in animal models of ADHD, the stimulant drugs methylphenidate and amphetamine are able to reduce levels of hyperactivity (Avale et al., 2004; Davids, Zhang, Tarazi, & Baldessarini, 2002). Animal models are generated by severing the dopamine system surgically or pharmacologically during the first few days of a rat's life (Avale et al., 2004). In order to disrupt central dopaminergic pathways, 6-hydroxydopamine (6-OHDA) is injected into the rat. This causes the mesolimbic dopamine system, which is related to locomotor activities and hyperactivity, to be underdeveloped. When the lesioned rats are in their adolescent period they exhibit hyperactivity, poor behavioral inhibition in approach/avoidance conflict tests, and deficits in continuously performed motor coordination tasks (Avale et al., 2004). When these rats are administered methylphenidate or amphetamine their hyperactivity levels decrease dramatically. This rat model suggests that decreased dopamine levels results in hyperactive behaviors and that the administration of exogenous dopamine (e.g., methylphenidate) reverses this problem so that the animal is no longer hyperactive. The same mechanism is purported to apply for humans.

Pharmacotherapy has been found to be an effective way of modifying hyperactive behaviors in children. Many people who show symptoms of inattention, hyperactivity, and impulsivity are diagnosed with attention-deficit hyperactivity disorder (ADHD), which is a disorder that affects 8-12% of children worldwide (Biederman & Faraone, 2005). Research has

suggested that the dysregulation of dopamine and norepinephrine underlies ADHD; therefore stimulant drugs, such as methylphenidate, which increase the synaptic availability of the neurotransmitters, are commonly used to treat the disorder (Biederman & Faraone, 2005).

One study compared the outcomes of four treatment strategies: stimulant medication, intensive behavioral treatment, combined stimulant medication and behavioral treatment, and standard community care, using 579 children with ADHD (Friemoth, 2005). Results showed that after 14 months of treatment, children in the stimulant medication group and the combined treatment group showed significantly greater improvement in social skills, anxiety, aggression, oppositional behavior, and academic achievement, than children who were only treated with behavioral therapy and the group of children who received community care. In addition, the only slight improvement was shown in hyperactivity levels when behavioral therapy was paired with medication, compared to when medication alone was used.

ADHD has an early age onset; impairment from symptoms of the disorder is evident as early as three years (Kratochvil, Greenhill, March, Burke, & Vaughan, 2004). In addition, there is epidemiological data that suggest that approximately 2% of children between the ages of 2 and 5 meet the diagnostic criteria for ADHD. A review of six available controlled trials of stimulants in preschool children also revealed that stimulant drugs help reduce symptoms of ADHD (Kratochvil et al., 2004). All of these six trials evaluated methylphenidate and each of the trials reported improvement of ADHD symptoms with the drug stimulant in at least one setting. The trials all provided some support for the use of methylphenidate in the treatment of young children with ADHD.

The purpose of this study is to determine if methylphenidate has similar efficacy in dogs as it does in rat models of hyperactivity and in the human condition of attention-deficit

hyperactivity disorder. Behavioral problems, specifically hyperactivity, are some of the major factors involved in the decision to relinquish dogs to animal shelters or to euthanize the dogs. Although many researchers have acknowledged this existing problem, none have tested possible solutions, particularly using stimulant drugs to reduce hyperactivity in dogs. The current study examines the effect of two different doses of methylphenidate, along with a placebo dose, on the hyperactivity of dogs, using both objective and subjective measures. The effects of the methylphenidate will be found by obtaining owner self-report surveys of the hyperactivity levels of their dogs over time, in addition to measuring the activity levels of the dogs over the six week treatment period. The hypothesis is that according to both activity level scores and owner self-reports, both a standard dose of methylphenidate and a higher dose will decrease hyperactive behavior in dogs, while behavior will remain the same when taking placebo pills.

Method

Participants

There were 150 dogs in this study, who were considered to be hyperactive by their owners. The owners either refused to try behavioral training for their dogs, or had tried behavioral training in the past, but reported that it had no effect on improving their dog's behaviors. The participants were recruited through ads that were placed in the newspaper for people who have hyperactive dogs. All dogs were between the ages of 2 and 7; dogs under the age of 2 were not included because they may still be developing physically and their behaviors may improve naturally as they age. Dogs with any medical conditions that may preclude the use of methylphenidate (e.g., heart disease, hypertension) or that may cause hyperactive behavior (e.g., thyroid disease, brain tumors) were excluded from the study.

Prior to initiating this study, 50 “normal” dogs, who were volunteered by their owners, were used as a control. These dogs were also between the ages of 2 and 7. Their owners reported that they had no health problems and considered them to have normal behavior.

Materials

There were three treatment conditions in this study: Placebo, Standard, and High. The dogs in the Placebo group were given placebo pills, while those in the Standard dose group were given 0.25 mg/kg capsules of methylphenidate and the dogs in the High dose group were given 0.5 mg/kg capsules.

Actigraph readings were the main outcome measure. An actigraph is an electronic device that contains a motion sensor, known as an accelerometer. The accelerometer measures the magnitude of movement of the individual wearing it, as well as the steps that he or she takes. Activity is measured in units/minute. The actigraphs used in this study recorded the dogs’ movement and activity in non-volatile memory. The information was then transferred from the actigraph onto a computer for analysis. Before the actual study, researchers had the 50 normal dogs wear actigraphs for a seven-day period. This allowed researchers to determine means and standard deviations of physical activity levels in normal dogs. In order to qualify to be a participant in the actual study, locomotion of the dog must have exceeded two standard deviations of the units/minute of the control dogs.

Owner self-reports of their dogs’ behavior were also obtained as a second outcome measure. Every owner was given an eight-item survey that was used to measure the owners’ perceived hyperactivity of their dogs. The items addressed the dogs’ current level of hyperactivity, using statements such as, “My dog does not jump up on strangers when they enter the home,” and “My dog never barks.” Owners were instructed to read each statement and rate

the extent to which they agreed or disagreed with it, based on a 5-point Likert scale. Half of the statements were positive behaviors, while the other half were negative. For the negative behavior items, the numerical responses were added together, while the remaining four responses were first reversed (e.g. 1=4), before finding the sum. These two sums were added together, in order to find the overall sum. The higher the score, the higher the dogs' level of hyperactivity was at the time, according to the owners.

Procedure

The 150 dogs were randomly assigned to one of three treatment conditions, using a computerized random sequence. This was a double-blind experiment. All owners were given 84 capsules of the same size and color and were instructed to give one pill first thing each morning and the second pill 12 hours later. An actigraph was placed on each dog's collar two weeks prior to the treatment period. Actigraph readings were conducted one week prior to treatment and then once a week for the six-week treatment period. Owner self-reports were obtained pre-treatment, at the mid-treatment point (week three) and post-treatment.

Results

In this study, a 3x7 Repeated Measures Two- Way Analysis of Variance was computed in order to compare the activity levels of the three treatment groups over time. The significance level was set at .05 and the subsequent post hoc test were completed using Tukey's HSD. The dependent variable was the mean activity levels, measured by the actigraph in units/minute. The ANOVA showed that there was a main effect of Time, as well as a main effect of Dosage. There was also a significant interaction between Time and Dosage. The post hoc test showed that dogs who were in the High dose group had significantly lower levels of activity, according to the actigraph readings, than those who were in the Placebo group and the Standard dose group at

Weeks 3, 4, 5 and 6. As seen in Figure 1, the dogs in the Standard dose group also had significantly lower levels of hyperactivity than those in the Placebo group at Weeks 4, 5 and 6.

In addition, a 3x3 Repeated Measures Two-Way Analysis of Variance was computed to measure the owners' perceived level of hyperactivity of their dogs over time. Once again, the significance level was set at .05. In this case, the dependent variable was the mean ratings of the owners' self-report surveys. This ANOVA showed that there was a main effect of Time and a main effect of Dosage. There was also a significant interaction between Time and Dosage. Tukey's HSD indicated that owners reported a significantly lower level of hyperactivity for dogs in the High dose group at Mid-Treatment (Week 3) than those in the Standard and Placebo groups at Mid-Treatment. Owners also reported that dogs in the High dose group had a significantly lower level of hyperactivity at Week 6 than dogs in Standard dose and Placebo groups at Week 6. Dogs that were in the Standard dose group also had significantly lower hyperactivity levels than those in the Placebo group, according to owners. Figure 2 depicts the differences found among self-report ratings for the three conditions over time.

Discussion

Results from this study indicate that methylphenidate reduces symptoms of hyperactivity in dogs from both an objective and a subjective measure. Analyses indicated that dogs receiving a standard dose of methylphenidate and dogs receiving a high dose of the drug had significantly lower activity levels during the later weeks of the treatment period than those who were taking placebo pills. As expected, these analyses show that the stimulant drug methylphenidate effectively lowers the activity of hyperactive dogs. The results also indicate that a high dose of methylphenidate (.5 mg/kg) is more effective than a lower dose (.25 mg/kg) for dogs. Differences between the three conditions did not occur until Week 3. The delay was most likely

present because the effects of the methylphenidate did not set in until three weeks into the treatment period. The dogs' bodies were adjusting to the new stimulant and therefore did not properly respond immediately.

The results of the subjective outcome measure also indicated that the dogs' hyperactivity levels decreased significantly more when taking methylphenidate than when dogs were in the Placebo group. These data show that methylphenidate is in fact effective in eliminating undesirable hyperactive behaviors of dogs. Once again, a high dose of the stimulant drug was more effective than a lower dose in decreasing hyperactivity. The results also demonstrate the power of placebo drugs. Owners reported that their dogs were behaving significantly better, with few undesirable behaviors when receiving the high dose of methylphenidate than when receiving a placebo or a standard dose of methylphenidate, both Mid-Treatment and Post-Treatment. However, owners indicated on their self-report surveys that hyperactivity levels were significantly lower for dogs who were in the Standard dose group than those in the Placebo group only at Post-Treatment. There was no significant difference between subjective hyperactivity levels at Mid-Treatment for dogs in the Standard dose group compared to dogs in the Placebo group. Placebo effects are common in studies evaluating medicine and psychotherapy (Wampold, Minami, Tierney, Baskin, & Bhati, 2005). Although objective measures of hyperactivity indicated that there was a significant difference between activity levels of Placebo group dogs and Standard dose group dogs at Week 3, self-report findings differ. Owners were expecting to notice a difference in behavior, which altered their perceived outlook on their dogs' hyperactivity level. The significant difference between perceived activity in Standard dose dogs versus Placebo dogs in the Post-Treatment survey indicate that the placebo effect was only temporary.

According to both the objective and subjective outcome measure, a higher drug dose was more effective in eliminating hyperactive behavior than the standard drug dose. This was the first study ever conducted that tests how effective methylphenidate is on lowering hyperactivity levels of dogs. Therefore, experimenters were basing their knowledge of the drug on its efficacy in humans and in the animal model using rats and mice. In such a novel study, experimenters had to be careful not to use an extremely high dose of methylphenidate, which may have been harmful for the participants. The dosage used in this study was based off of the appropriate human dosages for this particular drug. Results have shown that the higher dose is more effective, which may or may not imply that an even higher dose would further decrease hyperactivity levels. Future studies should use slightly higher dosages when testing the effects of methylphenidate on dogs, in order to examine whether or not the high dosages are more effective.

Although the study was carefully constructed with appropriate subjective and objective outcome measures, it is important to note the possible limitations of the design. The treatment period in this study was six-weeks long. This time period allowed experimenters to examine the short-term effects of methylphenidate on hyperactivity of dogs. However, it inhibited the ability to study the long-term effects of stimulant drugs for dogs with hyperactive behaviors. It would be interesting to conduct a longitudinal study that examines whether or not the positive effects of methylphenidate persist over a long period of time. When treating a person with ADHD using medication it is important that the drugs continue to be effective for the entire period of time that the person is taking them. Similarly, in order to completely eliminate hyperactivity in dogs, the medication must be effective for months and possibly for years.

Experimenters also neglected to take side effects of the stimulant drug into account.

Studies with human participants have shown that use of stimulants to manage symptoms of ADHD result in appetite and weight loss (Biederman & Faraone, 2005). Although most children with ADHD who are taking medication continue to grow, the growth in height is less than expected. Side effects of clonidine and guanfacine, two drugs that are used in the treatment of ADHD but are not routinely prescribed, include sedation, drowsiness, and depression. Owners did not mention noticing any side effects of the drug on their dogs, which suggests that side effects of methylphenidate do not exist when administered to dogs, rather than humans. However, a future study examining the effects of methylphenidate, or another type of drug used for treatment of ADHD, on dogs should take side effects in consideration. Experimenters should not only properly document hyperactivity levels, but they should also record any additional changes in dogs.

Findings from this study indicate that a dog's hyperactivity level dramatically decreases when he or she is taking the stimulant methylphenidate. Dog owners should take this notion into consideration when dealing with their hyperactive dogs. As noted previously, behavioral problems are the main reason that owners give when asked why they relinquished their dog to an animal welfare agency or why they euthanized their dog (Salman et al., 2000). These fatal actions can be avoided by administering methylphenidate to dogs twice a day. Veterinarians should strongly encourage the use to this stimulant when dealing with clients who are complaining about their hyperactive dogs. This simple solution is a much easier alternative to behavioral training and it can save thousands of lives.

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Appendix

Owner Self-Report Survey

Strongly Disagree	Disagree	Neutral	Agree	Strongly Agree
1	2	3	4	5

For questions 1- 8, please refer to the Likert Scale above. Indicate the extent of your agreement or disagreement by circling the appropriate number.

1) My dog is easily excitable.

1 2 3 4 5

2) If my dog is in an excited state when someone enters the home, he or she will calm down within a ten minute time period.

1 2 3 4 5

3) My dog seems to never sit still.

1 2 3 4 5

4) My dog does not jump up on strangers when they enter the home

1 2 3 4 5

5) It is difficult to control my dog in public places.

1 2 3 4 5

6) My dog never barks

1 2 3 4 5

7) Family members, friends, and strangers try to avoid my dog because of his or her bad behavior.

1 2 3 4 5

8) My dog is constantly running around.

1 2 3 4

Figure Captions

Figure 1. Mean activity levels (units/min) as a function of dosage and time of treatment.

Figure 2. Mean of owner self-report ratings of dogs' hyperactivity as related to dosage and time of treatment.

Figure 1

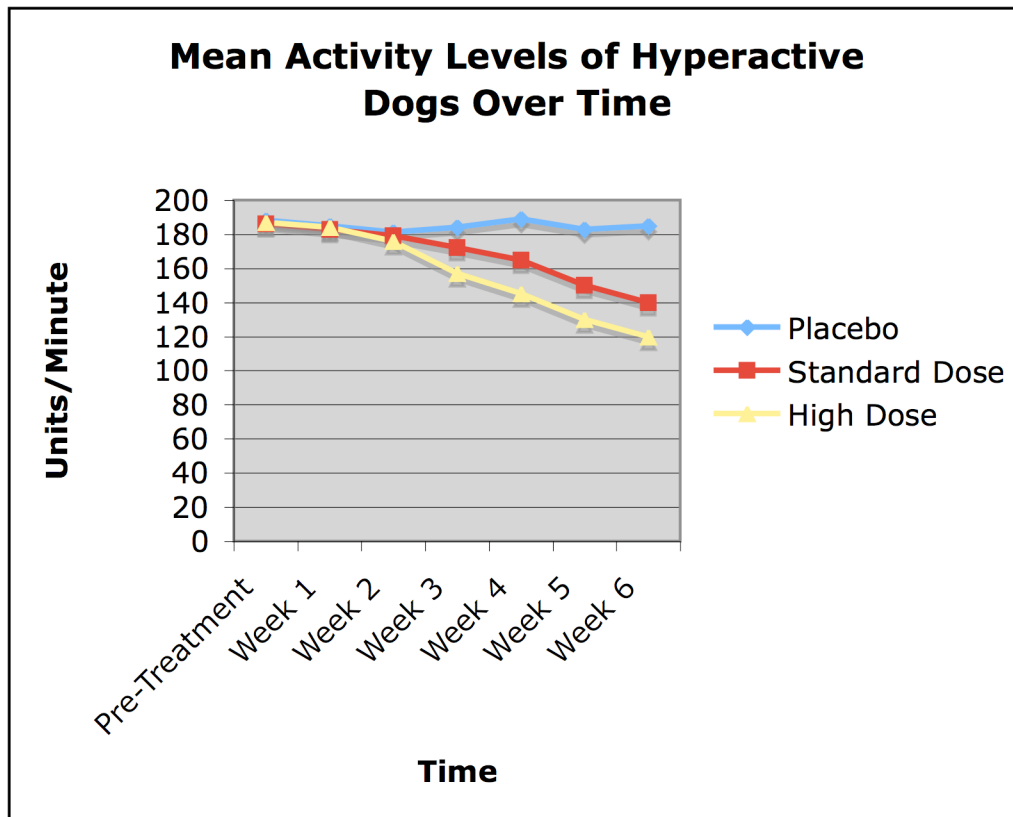


Figure 2

