Evaluation of the prevalence of urinary incontinence in spayed female dogs: 566 cases (2003–2008)

Kara M. Forsee, DVM; Garrett J. Davis, DVM, DACVS; Emily E. Mouat, DVM;
Katharine R. Salmeri, DVM, DACVS; Richard P. Bastian, PhD

Objective—To determine the prevalence of urinary incontinence in spayed female dogs and categorize affected dogs by age at time of ovariohysterectomy, number of litters prior to ovariohysterectomy, body weight, treatment of affected dogs, and severity of incontinence and to determine associations among these variables.

Design—Retrospective case series.

Animals—566 ovariohysterectomized dogs.

Procedures—An attempt was made to contact owners of 912 dogs ovariohysterectomized between January 2003 and January 2008 to discuss presence or absence of urinary incontinence. The actual number of responders was 566. Those owners with incontinent pets received a questionnaire further assessing degree of incontinence, diagnostic testing, treatment, and history.

Results—The prevalence of acquired urinary incontinence was determined to be 5.12% (29/566 dogs) on the basis of results of phone surveys and questionnaires. There was no significant difference in the age at time of ovariohysterectomy between incontinent and continent groups. A significant association was found between body weight and incontinence, with incontinence rates higher among larger (≥ 15 kg [33.1 lb]) dogs. Larger dogs were approximately 7 times as likely (OR, 7.2 [95% confidence interval, 2.5 to 21.1]) to develop acquired urinary incontinence, compared with small dogs (< 15 kg).

Conclusions and Clinical Relevance—Although acquired urinary incontinence in female dogs is known to be associated with ovariohysterectomy, the prevalence in this study was low. (*J Am Vet Med Assoc* 2013;242:959–962)

Acquired urinary incontinence in female dogs is a recognized long-term sequela to OHE. Previous studies[1–3] report a prevalence of up to 20%. Reported risk factors have included specific breeds, medium to large stature, tail docking, and obesity.[4] It has been shown that affected bitches have shorter urethras, reduced urethral tone, and more caudally positioned bladder necks, compared with those of continent bitches.[4,5] In the United Kingdom, a 5-year cohort study[2] revealed a 10-year cumulative incidence of 16% for AUI in spayed females but a low response rate for follow-up of 7%. It is possible that there may be regional differences in AUI rates between the United States and United Kingdom. Howe et al[6] evaluated complications of prepubertal gonadectomy and found that only 2% of patients spayed in the prepubertal period were affected by urinary incontinence with a follow-up no earlier than 41 months.

Although a complete diagnostic workup including urinalysis and imaging studies is ideal in dogs with AUI, in many cases, a presumptive diagnosis of USMI is made on the basis of history, absence of abnormalities on physical examination, and response to an estrogen compound, an α-adrenergic receptor agonist, or both. Although not all dogs respond to these treatments, improvement in clinical signs supports the diagnosis of USMI.[7,8] In refractory cases, further diagnostic testing may be performed to confirm a decrease in urethral closure pressure. Because estrogen concentrations are similar between continent anestrous dogs and incontinent spayed dogs[7] and the onset after OHE is so variable, there is likely another component to the acquired USMI. The collagen content and ratios of the periurethral tissues have also been evaluated.[9] It has been determined that there is no significant difference in collagen values between sexually intact and spayed female dogs.[9] Ultimately, the cause of AUI is unclear, but recent work by several groups[10–13] suggests that urinary incontinence following OHE may be related to changes affecting the structure and function of the lower urinary tract. Further investigation is needed to determine the multifactorial pathogenesis of canine urinary incontinence.

It is our experience that the prevalence of AUI is much lower than the reported 20%. The purpose of the

Abbreviations

AUI	Acquired urinary incontinence
OHE	Ovariohysterectomy
USMI	Urethral sphincter mechanism incompetence

From Red Bank Veterinary Hospital, 197 Hance Ave, Tinton Falls, NJ 07724. Dr. Forsee's present address is Blue Pearl Veterinary Specialty and Emergency Medicine for Pets, 11950 W 110th St, Overland Park, KS 66210.

The authors thank Laurie Rose for assistance with data collection and analysis.

Address correspondence to Dr. Forsee (kara.forsee@yahoo.com).

study reported here was to identify the prevalence and determine associations of AUI with specific variables in a large population of ovariohysterectomized dogs. We hypothesized that the prevalence of incontinence in the spayed population would be significantly lower than previously reported. We also hypothesized that there is not an association with age at time of OHE and that there is an association with the size of the animal.

Materials and Methods

Case selection and medical records review—Medical records from a large referral and general practice hospital of dogs ovariohysterectomized between January 2003 and January 2008 were reviewed in January 2009. The practice is composed of > 15 general practitioners and several specialists and is located in a suburban area. Review of the medical records included pertinent history, physical examination findings, diagnostic testing, and prescriptions. All owners were questioned as to whether their pet had urine leakage or urinary incontinence, described as either nocturia or unconscious leaking of urine, and whether their pet had any litters prior to OHE. If owners responded that their pet was incontinent, this was further characterized by time of day and activity during leakage; the owners of these ovariohysterectomized dogs were informed of and consented to a follow-up questionnaire to further characterize their experiences and history regarding the urinary incontinence.

Written questionnaires (**Appendix**) were then mailed or discussed by phone if there was no response by mail. The questionnaire was the same whether it was discussed by phone or filled in by the owners. The questionnaire included fill-in-the-blank questions regarding time of development of incontinence in relation to OHE, characterization of the incontinence (eg, continuous, intermittent, when awake or asleep, during submission or excitement), whether the pet had been evaluated for incontinence by a veterinarian, what diagnostic tests had been performed regarding incontinence, what treatment had been attempted, surgeries performed, severity of incontinence (measured by the owners on a scale from 1 to 10, with 10 being the most severe), reason for OHE (elective vs emergency), and whether the patient had any estrus cycles prior to OHE. Owners were asked to qualify the severity of incontinence (eg, by describing constant, intermittent, or rare leaking).

Data analysis—Data were analyzed with statistical software.[a] Incontinence, the outcome variable, was treated dichotomously. Dogs with other urinary abnormalities including submissive urination, polyuria, or urinary tract infections were excluded. Available medical records allowed for categorization of 4 factors. Age at time of OHE was categorized into 3 groups: < 6 months old, 6 to < 18 months old, and ≥ 18 months old. Body weight was categorized into 2 groups: < 15 kg (33.1 lb) and ≥ 15 kg. Number of litters was categorized dichotomously as 0 or ≥ 1. Finally, reason for OHE was categorized dichotomously as elective or emergency. Given the dates of OHE in the study population, the range of time between surgery and our speaking to pet owners to verify incontinence was 4 to 7 years.

Statistical analysis—Univariable associations between incontinence and each of the factors were tested via χ^2 tests of independence (Pearson χ^2 or Fisher exact test). Cochran-Mantel-Haenszel tests of conditional associations and Breslow-Day and Tarone tests of homogeneity of ORs were conducted to check for confounding and interactions with any significant associations. If appropriate, the Mantel-Haenszel common OR estimate was computed. Multivariable analysis with logistic regression was used to determine whether incontinence was related to the 4 factors, including testing for confounding and interactions, following the guidelines in Hosmer and Lemeshow.[14] For all univariable analyses, a value of $P < 0.05$ was considered significant. In the multivariable logistic regressions, the probability for removal from the model was 0.1. All metric descriptive data are presented as mean ± SD or as percentages.

Results

Five hundred sixty-six of 912 (62%) owners responded to the phone questionnaire. The 346 that were not reached were unavailable by phone (n = 62), were inactive clients (199), or were owners of a patient that was now deceased (85). Of the 566 dogs for which owners responded, 48 were reported to have micturition abnormalities. Upon further review, 29 of the 566 patients were urinary incontinent (5.12%), which was a significantly lower proportion than previously reported[3] ($P = 0.012$; 95% confidence interval for difference, 0.002 to 0.118). On the basis of phone interviews (n = 16) and the written questionnaire (3), the remaining 19 dogs were determined to have micturition abnormalities, including polyuria, pollakiuria, or submissive urination, but urinary incontinence was not documented, and these dogs were excluded. The diagnosis of AUI was made on the basis of the history obtained from the owner via telephone (n = 18) or the written questionnaire (11). Urinary incontinence developed at a mean age of 3 years, according to owner reports and diagnostic codes in medical records (range, 1 to 5.25 years). The time between OHE and our speaking to pet owners to verify incontinence was 4 to 7 years. The mean time from OHE to the development of incontinence was 2.3 years (range, 0.5 to 4 years).

Only 1 of the 26 uniparous dogs (3.84%) was incontinent, compared with 28 of the 540 (5.18%) nulliparous dogs. These proportions were not significantly different ($P = 1.00$; Fisher exact test). No significant difference was detected in dogs spayed on an emergency basis, compared with those spayed during an elective appointment (4.76% vs 5.12%; $P = 1.0$).

The data for age at time of OHE were as follows: 109 of 566 (19.3%) dogs were < 6 months old, 355 of 566 (62.7%) were 6 to < 18 months old, and 102 of 566 (18%) were ≥ 18 months old. There was no significant difference across these 3 age categories (Pearson $\chi^2 = 0.235$; 2 degrees of freedom; $P = 0.889$) in the proportions of incontinent dogs, which were 6 of 109 (5.5%), 17 of 355 (4.8%), and 6 of 102 (5.9%) dogs, respectively.

Two hundred ninety-two (52%) dogs were small (< 15 kg), and 274 (48%) were medium or large (body weight ≥ 15 kg). The incontinence rate was 4 of 292

(1.37%) for small dogs and 25 of 274 (9.12%) for medium or large dogs, which was a significant difference ($P < 0.001$; Fisher exact test). The OR for incontinence in small versus medium or large dogs was 7.22 (Pearson $\chi^2 = 17.48$; 1 degree of freedom; $P < 0.001$; 95% confidence interval, 2.5 to 21.1). The association between body weight and incontinence was found to be independent of age category, number of litters, and reason for OHE (Cochran and Mantel-Haenszel tests; $P < 0.001$ in all cases). The OR for incontinence and body weight was homogeneous across the various ages, litters, and reasons for OHE, and because homogeneity was not rejected, an estimate of the common OR was also calculated and found to be in high agreement for all variables. These results suggested no confounding or interaction by any other factor on the association between incontinence and body weight.

Multivariable logistic regression revealed the only significant contributor to the odds of incontinence was the body weight category (omnibus test, $P < 0.001$; Hosmer and Lemeshow test, $P = 0.694$; Wald test, $P < 0.001$). The OR for small dogs relative to medium or large dogs for AUI was 0.138 (95% confidence interval, 0.048, to 0.404). Therefore, larger dogs were 7.2 (1/0.138 = 7.24) times as likely to develop AUI, compared with small dogs. The interaction term between age and body weight categories was not a significant contributor to the odds of incontinence, and the age category alone neither was significant nor changed the coefficient for the body weight factor by a clinically significant amount (from –1.978 to –1.976, which only changed the OR to 0.139 or [1/0.139] 7.19).

Discussion

The overall prevalence of urinary incontinence, as defined by nocturia and unconscious leaking of urine, in this population of spayed females was 5.12%. This is significantly lower than previously reported[3] ($P = 0.012$; 95% confidence interval for difference, 0.002 to 0.118).

It has previously been noted that large-breed dogs weighing > 20 kg (44 lb) more frequently develop AUI, compared with the frequency in small-breed dogs.[15,16,b] In our study, a significant association was found between body weight of the dogs and development of incontinence, with large breeds (≥ 15 kg) having a higher rate of incontinence. We were unable to demonstrate an association between incontinence and emergency procedure or previous parturition. Additionally, prepubertal OHE has traditionally been thought to predispose an animal to urinary incontinence. The term prepubertal or early age gonadectomy refers to any time prior to 24 weeks.[6,17] We found no significant difference between the age group at time of OHE and incontinence. This finding is consistent with a previous study[6] of long-term complications of prepubertal gonadectomy where urinary incontinence was identified in only 2% of the dogs spayed prepubertally, defined as < 24 weeks old, and this number was not significantly higher than the number of dogs spayed at a traditional age. This finding is contrary to another article[17] evaluating the long-term risks and benefits of early-age gonadectomy in dogs. In that study, the investigators found that those dogs spayed at < 3 months had an incontinence rate of 13%. They found that those dogs spayed at older than 3 months old had an incontinence rate of 5%. These conflicting studies[6,17] identify early gonadectomy differently. All dogs in our study that were spayed at < 6 months were older than 12 weeks of age at the time of OHE. On the basis of our study, we cannot make any conclusions regarding incontinence rates in dogs spayed younger than 12 weeks old.

In our study, only 1 of the 21 emergency cases was incontinent. Additionally, only 1 of the 26 uniparous dogs was incontinent. Although there was no association found between either of these factors and incontinence, strong conclusions cannot be made regarding these factors and a study evaluating significantly higher numbers of cases is recommended.

One of the limitations of our study is that it is retrospective. Additionally, the follow-up time ranged from approximately 4 to 7 years, so a portion of the dogs evaluated may develop incontinence in years to come. The results of previous studies[1,18] suggest it may take up to 12 years for AUI to develop, so a longer follow-up may affect the results. Despite this, the study by Arnold et al[1] also demonstrated that 75% of those that will develop AUI after OHE will do so within 3 years.[1] de Bleser et al[19] found that bitches > 12 years of age were 3.7 times as likely to develop incontinence as were bitches < 8 years.[19] However, as in our study, a limitation is that the results were based on questionnaires and there is a possibility, especially in geriatric dogs, that there are underlying conditions that may lead to micturition disorders. Also, the subjective assessment of an owner regarding urinary incontinence may have caused some dogs to be included or excluded from the incontinent group.

Additionally, recall bias needs to be considered, such that owners may be more likely to consider their pets incontinent after learning of the increased prevalence associated with OHE. Efforts were made to fully assess, albeit subjectively, the severity of the incontinence. One way this was done was to review the medical records to identify medical evidence of incontinence. This allowed us, in some cases, to distinguish other conditions such as endocrinopathies, urinary tract infections, or submissive urination, which owners may have misinterpreted as urinary incontinence. The questionnaires included open-ended questions so as not to lead owners to any particular assessment. One downfall of the questionnaires relates to the scale of the severity of incontinence. This scale was a subjective description by the owners, and the scale and questionnaire have not been used or validated in previous studies. If the questionnaires were returned via mail rather than answered over the phone, people may be less inhibited and more forthcoming with their answers. Additionally, the 346 clients who were considered nonresponders could introduce a bias. These clients were unavailable by phone or were inactive clients, or their pets were deceased. Not including these clients in the analysis could lead to exclusion of older dogs that may have developed incontinence but had died since the start of the study. Inactive clients may have moved to another state or been dissatisfied with their service. This could

introduce a bias if owners of incontinent dogs are dissatisfied because of development of incontinence after OHE, which could lead a number of incontinent dogs to not be included in the analysis.

Dogs that were ovariohysterectomized for dystocias or pyometras were often older and may not have been included if they were deceased or inactive patients, so the number of incontinent dogs in this group may be artificially low. The dogs with suspected AUI had not all been thoroughly evaluated for their incontinence; therefore, it is possible that some of these cases of suspected AUI may have been the result of anatomic anomalies, neurologic deficits, or other causes, rather than associated with OHE. In a future study, these incontinent dogs could be further classified and other underlying causes could be ruled out by a thorough workup. A final limitation, mentioned earlier, is the small number of dogs with incontinence in many of our association tests. Studies with even larger overall samples sizes, or of specific populations where the prevalence of incontinence is higher, may provide more conclusive results in these areas.

The purpose of this study was to identify the prevalence of incontinence as well as possible associations with age, body weight, emergency OHE, and number of litters prior to OHE. Though AUI is a known risk of OHE, the prevalence is relatively low.

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Appendix

Questionnaire mailed to or discussed by phone with 29 owners of incontinent female dogs following OHE to assess the degree of incontinence, diagnostic testing, treatment, and history.

1. When did you first notice your pet being incontinent in relation to the time of birth and spay?
   a. Please characterize the incontinence to the best of your ability (eg, time of day, only when excited, during sleep, continuous, intermittent).
2. Has your pet been evaluated for the incontinence? Yes or No
   a. What diagnostic tests have been performed in regards to the incontinence?
   b. Is your pet currently on any medications to treat the incontinence?
   c. Has your pet had back surgery or difficulty walking?
3. On a scale from 1–10, 10 being the most severe, how would you rate the severity of urinary incontinence affecting your pet? How do you qualify the severity (eg, constant urine-stained hair or furniture, discomfort, or redness)?
4. Was your pet spayed as a result of pyometra, difficulties delivering puppies, or other uterine diseases?
5. Did your pet experience any heat cycles (ie, bleeding from the vulva) prior to being spayed?
6. Is your pet otherwise healthy? If not, please list other medical problems.

Additional comments: