

Outcomes of Adoption of Adult Laboratory Ferrets After Gonadectomy during a Veterinary Student Teaching Exercise

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We surveyed 27 people who had adopted a total of 43 adult domestic ferrets after their use in a series of veterinary student surgery teaching laboratories to assess the success of those adoptions and to determine the rate of occurrence of common maladies of domestic ferrets after adult gonadectomy as compared with the usual practice of early-age gonadectomy. The adoptions took place 1–7 y prior to the survey. The response rate was 48% of adopters, covering 53% of the ferrets. Overall the success of former breeding and instructional ferrets as pets were rated as 91% good or excellent and 4.5% poor. Behavioral issues (for example, nipping, failure to litter train) were noted as the most common problems (36% of ferrets). Adrenal gland disease, insulinoma, or lymphosarcoma occurred in 23% of all ferrets and accounted for 57% of those ferrets that had died prior to the time of the survey.

Adoption of laboratory animals as an alternative to euthanasia is a complex and controversial subject.^{1,5,22} Disease containment and potential liability issues if animals are adopted are justifications for maintaining laboratory animal facilities under a closed no-exit system. Animals with limited socialization stand a reduced chance of making good pets. Limited funding to support adoption programs is an additional impediment to postinvestigation placement of laboratory animals with private owners. Conversely, an adoption program for laboratory animals can enhance the morale of laboratory animal caretakers, provide positive public relations for a facility, and constitutes an additional refinement in laboratory animal use.² Follow-up surveys on laboratory animals placed in adoption programs are crucial to evaluating the advisability of such programs, but published accounts are scarce,^{1,5} and to our knowledge, none include ferrets.

In the pet trade, domestic ferrets (*Mustela putorius furo*) typically are spayed or neutered and have their anal sacs removed at about the time of weaning (6 to 8 wk of age), before arrival at pet stores for sale.^{18,21} These procedures are thought to make the ferrets more attractive to buyers and have been shown to reduce the likelihood of certain conditions and tumors that can affect intact ferrets (for example, hyperestrogenic anemia in female ferrets,⁹ testicular tumors in male ferrets).¹³ However, the high prevalence of adrenal gland disease (hyperplasia, adenoma, adenocarcinoma) in ferrets in the United States has led to concern that early-age gonadectomies may predispose ferrets to these endocrine diseases,^{3,19,21} although time from neutering may be more important than age of neutering.²⁰ Other proposed causes include genetic predisposition, a retrovirus, unnatural light cycles, and high-carbohydrate diets.²¹ A proposed mechanism is that loss of testosterone and estrogen production by the gonads leads to compensatory hypophyseal production of luteinizing hormone and follicle-stimulating hormone, which then act on

sex-steroid-producing cells in the adrenal glands.³ In addition, insulinoma and lymphoma have been linked to gonadectomy in ferrets.¹⁴

As part of an advanced ferret medicine course taught at the North Carolina State University College of Veterinary Medicine, adult ferrets are acquired from a commercial breeder and undergo gonadectomy and anal saccullectomy in a veterinary student surgery instruction laboratory. Ferrets are adopted out after the course. We sought to assess the success of placing laboratory postinstructional ferrets in homes as pets and to determine the effect of adult gonadectomy on development of adrenal gland disease, insulinomas, and lymphomas in ferrets.

Materials and Methods

Adult ferrets were acquired from a commercial ferret breeder for use in a week-long ferret medicine and surgery course. All recently received vaccinations against rabies and canine distemper. The age of individual ferrets was unknown, but most are retired breeders. They were housed individually in standard stainless-steel laboratory cat cage units modified to prevent ferret escape through the water bowl opening. The ferrets were fed once daily with a commercial ferret food and were provided with a water bottle, a small enclosed sleeping area with towel bedding, and a cardboard litter area. The enclosures were cleaned and changed daily, and the room was kept under a 12:12-h light:dark cycle.

During this course, 1 or 2 ferrets were assigned to groups of 3 veterinary students and treated as elective surgery patients. Physical examination, blood collection for complete blood counts and serum biochemical profiles (all were within normal limits), fecal examination for parasites (none were found), and anesthesia for gonadectomy and anal saccullectomy were performed on each ferret. After full recovery from surgery and clearance by the laboratory animal veterinarians for release, ferrets were made available for adoption. All procedures, including adoption, have been approved by the NCSU Institutional Animal Care and Use Committee. Potential adopters were recruited through NCSU College of Veterinary Medicine electronic mailing lists and by word of mouth. Although the screening process of potential

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adopters was not formalized, trained laboratory animal personnel discussed ferret care with adopters and provided counseling on issues such as avoiding placement in homes with infants.¹⁶ There was a nominal processing fee of \$25 associated with the adoption and a no-return policy. A maximum of 3 ferrets could be adopted per person annually.

In December 2003, a telephone survey (Figure 1) was conducted to follow up on ferrets that had been adopted after the course. Contact information collected at the time of adoption, print and Internet phone directories, and the American Veterinary Medical Association directory were used to track owners. The survey took approximately 10 min to complete. Surveys were conducted by veterinary students in the ferret medicine class. Questions were designed to elicit information on how well the ferrets integrated into the household (with people and other pets, if any), what behavioral problems occurred, what continued medical care they received, and what medical problems they later developed and an overall assessment of the owner's perceptions regarding the success of the adoption. The survey covered animals adopted from classes in December 1996 (n = 6), May 1997 (n = 4), December 1998 (n = 11), December 2001 (n = 10), and December 2002 (n = 12), for a total of 43 (8 male, 35 female) ferrets adopted by 27 people. Results are presented as percentages, medians, and ranges. Minimal incidences of particular diseases were calculated according to the total years since adoption (if still living) or until death or when lost to follow-up, because time of diagnosis could not be reliably collected. Commercial statistics software (JMP 5.0, SAS Institute, Cary, NC) was used to calculate 95% confidence intervals.

Results

Surveys were completed by 13 respondents (48%) and accounted for 23 ferrets (53%), including 1 of 6 (17%) from December 1996, 0 of 4 from May 1997 (0%), 8 of 11 (73%) from December 1998, 5 of 10 (50%) from December 2001, and 8 of 12 (67%) from December 2002. Of the 23 ferrets, 3 were male, and 20 were female. The median number of ferrets adopted per person was 1 (range, 1 to 4). The person who adopted 4 ferrets obtained 2 in 1 y and an additional pair 4 y later. All respondents had some connection to the veterinary school at the time of adoption, with 7 being veterinary students (6 of whom were taking the ferret course), 3 staff, 1 graduate student, 1 spouse of a faculty member, and 1 veterinary student's friend (who subsequently became a veterinary student). Of the 23 ferrets, 16 were adopted for the adopter, and 7 were adopted for someone else. One ferret adopted for someone else was lost to follow-up and is not included in further totals. Another ferret was given away after 2 y and lost to follow-up but was in the adopter's household for sufficient time to allow questions to be answered for that period. At the time of the survey, 7 of the 22 ferrets had died, 14 were living, and 1 was unknown. Ferrets that had died lived a median of 4 y (range, 1 to 5 y) after adoption. Ferrets still living had been adopted a median of 1 y (range, 1 to 5 y) previously. Nineteen ferrets were adopted into 11 households with other companion animals, and 3 were adopted into 2 households with no other pets. Eight ferrets were adopted into 4 households that already had 1 or more ferrets.

Overall ratings of the adopted ferrets as pets were 13 excellent (59%), 7 good (32%), 1 fair (4.5%), and 1 poor (4.5%). Respondents indicated that other household members (when present) would rate the ferrets similarly or higher. On a respondent basis, 7 rated their pets as excellent, 3 as good, 1 as poor, and 2 provided split ratings for their ferrets (1 good and 3 excellent; 1 fair and 1 excellent), for 92% granting good to excellent ratings

and 8% granting a poor rating. A slightly lower percentage of respondents (77%) indicated they would be willing to get another ferret, whereas 33% indicated they would not get another ferret. Identical response rates were recorded for those willing to adopt another postinstructional ferret. In 19 households with other companion animals, 3 ferrets were graded as integrating poorly with the other pets, 6 as fairly well, 7 as quite well, and 3 as exceptionally well. Notes volunteered for this question included 1) a requirement for supervised interactions, 2) a nonfatal bite of a cockatoo, and 3) that 2 ferrets "terrorized" the 4 cats of the household. Three ferrets from 2 households noted to require supervised interactions with other pets received excellent overall ratings as pets, and the 3 ferrets involved in the cockatoo bite incident and the 2 that terrorized the cats received good overall ratings.

When asked to volunteer whether there were any problems with their adopted ferrets, 8 respondents indicated that there were and 7 indicated that there were not (this includes 2 respondents who had ferrets both with and without problems). Problems were identified with 10 ferrets, and no problems with 12 ferrets. Eight volunteered problems were behavioral (nippiness, aggression, and failure to litter train), and 2 were health-related (1 insulinoma and 1 insulinoma plus suspect adrenal gland disease). Litter training was regarded as successful for 5 ferrets (although one of these started out intermittently successful), unsuccessful for 8, and partially successful for 9. Human bite frequency was scored as never for 11 ferrets, once or twice but nothing major for 2 ferrets, frequently nippy for 5 ferrets, drew blood once or twice for 1 ferret, and frequently drew blood for 3 ferrets. Of the 3 ferrets noted to draw blood frequently, 2 were nonetheless graded overall as good pets, and 1 was graded poor.

Since adoption, 19 ferrets had clinical veterinary visits, and 3 had none. Vaccinations against rabies and canine distemper were continued for 17 ferrets, only rabies for 1 ferret, and no further vaccinations for 4 ferrets. Adrenal gland disease was diagnosed (defined simply as diagnosis by a veterinarian) in 2 ferrets and suspected in 1 (minimal incidence of 0.06/y after gonadectomy, including the suspect case). Insulinoma was diagnosed in 3 ferrets (minimal incidence of 0.06/y), including 1 with suspected adrenal gland disease. Lymphosarcoma was diagnosed in 1 ferret (minimal incidence of 0.02/y), which also had adrenal gland disease. The overall incidence of diseases that have been associated with spay or neuter in the adopted ferrets (adrenal gland disease, insulinoma, and lymphoma or lymphosarcoma)¹⁴ was a minimum of 0.14/y after gonadectomy, with a prevalence of 23% (95% confidence interval, 10% to 43%) of ferrets being affected by at least one of the conditions. Among the 7 deceased animals, the cumulative incidence was 0.25/y after gonadectomy, with a prevalence of 57% (95% confidence interval, 25% to 84%) being affected by at least 1 of the conditions. No other neoplasias were diagnosed, and 2 animals underwent exploratory celiotomies (1 insulinoma, 1 adrenal gland disease). Other health problems diagnosed included 2 vaccination reactions (vaccines not specified), 2 sudden deaths of undetermined causes (at 4 and 5 y after adoption), 1 suspected *Helicobacter mustelae*-associated gastritis,¹⁸ and 1 renal failure.

Discussion

Weaknesses of the survey are the high rate of loss to follow-up leading to a relatively low response rate (48% of adopters for 53% of ferrets), a bias towards adopters with strong ties to the veterinary school who were more easily traced, and a greater rate of loss to follow-up for earlier adoptions leading to a bias

VMC 991B Ferret Adoption Questionnaire

Name of adopter: _____
 Contact information at time of adoption: _____
 Current contact information: _____
 Date of adoption: _____
 LAR Name of ferret: _____
 Other course ferrets adopted at same time or other time (name and date): _____

Hi, I'm _____, a student from the College of Veterinary Medicine, and I'd like to ask you some questions about a ferret from the ferret medicine selective that you adopted in _____ (year). As part of this year's course we are conducting a survey to see how those adoptions turned out. May I ask you some questions? (estimated time 10 minutes)

CIRCLE or fill in blanks for answers

1. At the time of the ferret adoption were you FACULTY OR STAFF of the veterinary school? VETERINARY STUDENT? GRADUATE STUDENT? FRIEND OR FAMILY of veterinary school faculty/staff/student? UNAFFILIATED with the veterinary school? If veterinary student, did you or were you taking the ferret medicine selective? YES NO

2. How did you learn that the ferrets were available for adoption?

3. Did you adopt the ferret for YOURSELF or for SOMEONE ELSE?
 If someone else, is that person in the same household or not? YES NO
 [List how related, if volunteered, but don't ask. _____]

If someone in a different household, may we contact that person?
 Get contact information:
 Name _____
 Phone number _____
 Email, postal address, whatever might help: _____

In case we have difficulty contacting _____, are you familiar enough with the ferret to try answering the rest of the questions? YES NO

4. When your ferret was adopted, it's short-term name was _____.
 Did you KEEP that name or CHANGE it? If changed, to what? _____

5. Do you still have _____? YES NO
 If your ferret has died, when? _____

6. How would you rate your ferret as a pet?
 POOR FAIR GOOD EXCELLENT

7. Would other members of your household give the SAME rating, a HIGHER rating, or a LOWER rating?

8. Did you encounter any problems with your ferret? YES NO
 If so, what were the problems?

9. Did/do you have any other pets at the same time as your ferret? YES NO
 If so, what kind and how many?
 DOG(S) _____
 CAT(S) _____
 FERRET(S) _____

10. How well did your ferret integrate with your other pets?
 [note: modify as necessary for different pet interactions]

POORLY FAIRLY WELL QUITE WELL EXCEPTIONALLY WELL

11. Did your ferret litter train well? YES NO SO-SO

12. Did your ferret ever bite anyone?
 NEVER ONCE OR TWICE, minor nips FREQUENTLY NIPPY but nothing major
 DREW BLOOD once or twice FREQUENTLY DREW BLOOD

13. Did your ferret ever have any medical problems? YES NO
 If so, what? _____

14. Besides the conditions you just mentioned
 Did a veterinarian ever diagnose your ferret with adrenal gland disease?
 YES NO
 Did a veterinarian ever diagnose your ferret with insulinoma/low blood glucose?
 YES NO
 Did a veterinarian ever diagnose your ferret with lymphosarcoma?
 YES NO
 If so, what? _____
 Did a veterinarian ever diagnose your ferret with any other tumor or cancer?

 For any yes answers to 13–14, how was the condition diagnosed (if known)?

15. Did your ferret ever have surgery since adoption, and if so, what surgery?

16. At the time of adoption, your ferret was currently vaccinated against rabies and canine distemper. Did you continue vaccinating against
 BOTH? CANINE DISTEMPER ONLY? RABIES ONLY? NEITHER?
 [note: record positive response for any vaccination protocol, not just yearly updates, elaborate on currency and schedule if that information is volunteered]

17. Approximately how many times has your ferret visited a veterinarian since adoption?
 ZERO
 ONCE
 2–5 TIMES
 MORE THAN 5 TIMES
 [Note: if the ferret was adopted into a veterinary household, this question refers only to clinical visits, whether in the home or office]

18. Would you ever get another ferret? YES NO

19. Would you ever adopt an adult ferret previously used for teaching like this ferret [or fill in name _____]? YES NO

Figure 1. Telephone survey used to collect information on adopted ferrets.

towards younger, more recently adopted ferrets. Nonetheless, the survey provides some useful information. With 91% of adopted ferrets rated overall as good or excellent pets and only 4.5% rated poor, and 77% of respondents indicating a willingness to adopt another laboratory ferret after its use in teaching exercises, we consider this adoption program to be successful. Caution is warranted, however, because some characteristic behavior issues that have been associated with ferrets appeared even in animals rated as excellent pets, including failure to litter train and nippiness, indicating a certain level of tolerance by the persons adopting the ferrets. Not all potential adopters would consider these characteristics to be traits of excellent pets. Features of this adoption program that may have favored its success include predominantly word-of-mouth advertising within the veterinary school community; self-identification of individuals with prior experience owning ferrets and an affinity towards the species; inclusion of some veterinary student adopters who had a week of intensive ferret training and bonding with their surgery animals; and setting a modest processing fee for adoption, thus requiring some level of commitment up front. Some of these features are in agreement with a study on relinquishment of dogs to an animal shelter, in which decreased risk of relinquishment was associated with purchase price and with regular veterinary visits,¹⁷ which may be facilitated by future veterinarians as adopters. In addition, a bias may have been introduced by the commercial ferret breeder, knowing these ferrets are to be adopted out after the class, in selecting ferrets with good temperaments. The typical timing of the course, in early December, sets up the possibility for ferrets winding up as ill-advised holiday gifts, and there is a certain financial pressure to have them adopted quickly to reduce per diem costs. But the option of keeping the ferrets in Laboratory Animal Resources over the holidays exists for those who prefer not to introduce a new pet into a household at an unsettled time, so the problem of ill-advised gifting does not appear to have been marked.

Adult intact female ferrets are smaller and males are larger than their early-age gonadectomized counterparts.⁴ This trait makes ferrets from the course unique, and in some cases more desirable by potential adopters. Controversy exists about the suitability of performing routine anal saccullectomies on ferrets, and some advocate against the procedure, considering it a form of mutilation,¹⁵ particularly in adults, in which the surgery is more involved than in juveniles. The surgery, commonly called 'descenting,' does not eliminate the typical ferret odor, which emanates from the diffuse sebaceous glands of the skin, but does eliminate the possibility of catastrophic malodorous discharges. Although we recognize merit in the position against anal saccullectomies, we choose to include the procedure in the course, both as a valuable teaching exercise for varied surgical training of our veterinary students and because the industry standard in the United States is for descented ferrets, which we believe makes our postinstructional ferrets more adoptable than if anal sacs are left in place. None of the adopted ferrets was reported to have fecal incontinence, a potential complication of anal sac removal,⁶ although this question was not included in the survey.

The age of the donated ferrets was unknown beyond their adult status, so speculation on life expectancy cannot be provided to potential adopters. The procurement agreement is for retired breeders (about 3 to 4 y of age), but in some cases younger adult animals may be provided. Females typically arrive in some state of estrus, and males are fully developed, so at the very least all animals are sexually mature at the time of surgery. The prevalence and incidence of adrenal gland disease,

insulinoma, and lymphosarcoma in these ferrets does not favor adult neutering as being protective against these conditions as compared with early-age neutering.

The actual prevalence of neoplasia in ferret populations cannot be estimated accurately, but reported prevalences of neoplasia in closed colonies¹³ and 1 medical database survey of veterinary teaching hospital ferret cases¹⁴ range from 0.5% to 21%, depending on the population sampled, with increasing prevalences in recent years. At 23% of all ferrets and 57% of ferrets that had died, our population is at or above the upper end of prevalences previously reported, but starting with adult and in some cases animals near the end of their reproductive years would tend to bias towards detection of neoplastic diseases. One report suggests that time from neutering is more important than the age of neutering in development of adrenocortical neoplasia in ferrets.²⁰ Our data are generally supportive of this view but lack key age information and an unneutered cohort to be conclusive. Other hypothesized causes of high prevalence of neoplasia in domestic ferrets include genetic predisposition, retroviruses, unnatural light cycles, and high-carbohydrate diets.²¹

In black-footed ferrets (*Mustela nigripes*) in captive breeding programs, the prevalence of a different set of neoplastic diseases is high, at 55%,¹² but nearly all occurred in ferrets 4 y of age or older—past their peak reproductive years. Many of the reported tumors of intact black-footed ferrets have some linkage to reproductive hormones (for example, mammary adenocarcinomas, perianal and anal sac adenomas and adenocarcinomas, and preputial gland adenomas and adenocarcinomas).¹² Ranched mink (*Mustela vison*) raised for pelts rarely live longer than 4 y, making them less likely to develop neoplastic disease,¹² but in a laboratory setting, aging mink 5 to 11 y old experienced a high prevalence of anal sac carcinoma.¹¹ When discussing the potential detrimental effects of early-age neutering of domestic ferrets, it is fair also to note the risks associated with failure to neuter. Early reports indicated that reproductive tumors were among the more common tumors of domestic ferrets,^{7,10,21} albeit not to the extent as more recent reports for endocrine and lymphoid tumors.^{14,21} In addition, intact female ferrets that are not bred when in estrus can remain in heat and suffer from hyperestrogenic anemia, which is life-threatening.⁹

In conclusion, our survey results indicate that postinvestigational or postinstructional adoption of laboratory ferrets can be highly successful, although characteristics of the pool of adopters may influence the outcome. In addition, we failed to find support for a protective effect of adult spaying and neutering of ferrets against adrenal gland disease, insulinoma, or lymphoma or lymphosarcoma, compared with the typical practice of early-age gonadectomy.

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