Article

Incorporation of exercise, using an underwater treadmill, and active client education into a weight management program for obese dogs

Anne Chauvet, Jim Laclair, Denise A. Elliott, Alexander J. German

Abstract — Physical activity improves outcome of weight loss in obese humans, but limited information exists for dogs. Eight obese dogs (body condition score 5/5), of various breeds and genders, undertook a 3-month weight-loss program which included exercise using lead walks and underwater treadmill exercise. The median number of treadmill exercise sessions per dog was 13 (range: 5 to 17). Median distance walked per session was 0.97 km (range: 0.05 to 2.7 km) (0.6 miles; range: 0.03 to 1.70 miles) and this increased sequentially over the course of the study ($P < 0.001$). Mean [± standard deviation *(s)*] percentage of starting weight loss over the 3 mo was 18.9 ± 5.44%, equivalent to a rate of weight loss of 1.5 ± 0.43% per week. Thoracic and abdominal girth also declined significantly during the program ($P < 0.0001$ for both). This study demonstrates the potential benefit of including an organized exercise regimen, utilizing an underwater treadmill, in conventional canine weight management programs.

Résumé — Intégration de l'exercice, à l'aide d'un tapis roulant aquatique et de la sensibilisation active des clients, dans un programme de gestion du poids des chiens obèses. L'activité physique améliore les résultats de la perte de poids chez les humains obèses, mais des renseignements limités sont disponibles pour les chiens. Huit chiens obèses (cote d'état corporel de 5/5), de diverses races et sexes, ont entrepris un programme de perte de poids d'une durée de 3 mois qui incluait de l'activité physique dans le cadre de promenades en laisse et d'exercice sur le tapis roulant aquatique. Le nombre médian de séances d'exercice sur le tapis roulant par chien était de 13 (intervalle : de 5 à 17). La distance médiane parcourue par séance était de 0,97 km (intervalle : de 0,05 à 2,7 km) (0,6 mille; intervalle de 0,03 à 1,70 milles) et ces données ont séquentiellement augmenté au cours de l'étude ($P < 0{,}001$). Le pourcentage moyen de la première perte de poids [± déviation(s) standard] au cours des 3 mois a été de 18,9 ± 5,44 %, équivalant à un taux de perte de moyen de 1,5 ± 0,43 % par semaine. La circonférence thoracique et abdominale a aussi baissé significativement durant le programme ($P < 0{,}0001$ pour les deux). Cette étude démontre les bienfaits potentiels de l'inclusion d'un régime d'exercice encadré, à l'aide d'un tapis roulant aquatique, dans les programmes conventionnels de gestion du poids des chiens.

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Introduction

Excessive body weight (overweight and obesity) is one of the most common medical disorders of dogs, and is linked to decreased longevity and a variety of diseases (1). In humans, reducing body weight even by modest amounts (5% to 10%) can reduce the risk of associated diseases, and improve patient quality of life (2). Similar beneficial effects have been reported in obese dogs with osteoarthritis, which successfully re-establish their optimal body weight after a weight reduction program (3). Although microsomal membrane transfer protein inhibitor drugs have recently received approval for the treatment of canine weight loss (4), most dogs are still treated with conventional strategies, involving dietary energy restriction combined with

Veterinary Neuro Services, 3900 Clark Road, Building M, Unit 4, Sarasota, Florida, USA (Chauvet); Jim LaClair's Dog-Friendly Dog Training, 5131 Oxford Drive, Sarasota, Florida, USA (LaClair); Royal Canin USA, 500 Fountain Lakes Blvd, Suite 100, St. Charles, Missouri 63301, USA (Elliott); Department of Veterinary Clinical Sciences, University of Liverpool, Leahurst Campus, Chester High Road, Neston, Wirral CH64 7TE, United Kingdom (German).

Address all correspondence to Dr. Alexander German; e-mail: ajgerman@liv.ac.uk

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The diets used for the dogs undergoing weight loss in this study are manufactured by Royal Canin. Dr. German's post is supported by Royal Canin. Dr. Elliott is employed by Royal Canin.

Table 1. Composition of the diet used for weight loss

Criterion		Diet characteristics	
ME content		3526 kcal/kg	
	per 100 g AF	per 100 g DM	g/1000 kcal (ME)
Moisture	9.0	—	—
Crude protein	34.0	37.4	96.4
Crude fat	10.0	11.0	28.4
Carbohydrate	35.3	38.8	100.1
Ash	9.0	9.9	25.5
Crude fiber	2.7	3.0	7.7

Royal Canin veterinary diet® calorie control cc32™ high protein Royal Canin USA.
ME — metabolizable energy content, as measured by animal trials according to the American Association of American Feed Control Officials protocol (22).
AF — as fed.
DM — dry matter.

Table 2. Starting characteristics of the dogs in the study

Criterion	Cases
Breed	American bulldog, American pitbull, beagle, Chihuahua, crossbred, Labrador, shih tzu, Siberian husky
Gender	Neutered male (6), neutered female (2)
Age (years)	6 (3 to 10)
Starting body weight (kg)	26.4 (7.6 to 69.7)
Target body weight (kg)	18.9 (5.4 to 49.8)
Body condition score	5 (5 to 5)

All data are expressed as median (range).

increasing activity levels. Whilst there have been numerous studies examining the effect of dietary caloric restriction on weight loss (5–9), the effect of lifestyle changes and exercise remain little studied in companion animals.

Physical activity induces negative energy balance in patients whose energy intake is regulated and, in humans, can result in weight loss (10–12). Substantial weight loss can also be achieved with exercise alone, if energy intake remains unchanged and compliance with exercise is good (13,14). The required amount of exercise, however, is high and presents a challenge in terms of the necessary commitment. In general, the beneficial effect of exercise on weight loss is only modest, compared with restricting energy intake. Nonetheless, including exercise in a weight loss regimen confers numerous additional benefits including a reduction in total and visceral fat, a reduction in skeletal muscle lipid, and improved fitness levels (15–17). A recent study in children has also demonstrated a negative association between the degree of physical activity and a composite score of cardiovascular risk factors, which was independent of the degree of adiposity (18).

Given the limited current information on the effect of exercise and lifestyle alterations in canine weight-loss programs, the aim of the current study was to examine the effect of an organized exercise program and lifestyle education on the rate of weight loss in obese client-owned dogs.

Materials and methods

Patients

Eight markedly obese [all body condition score (BCS) 5/5] client-owned dogs participated in a 3-month weight management program (Big Dog Big Loser™) between January and April 2007. Detailed information on their prior nutritional history was limited; all had been fed commercial diets, and had also been fed various extras, including dog treats and table scraps. To facilitate case recruitment, subsidized diet food was provided throughout the study, and a prize was awarded to the dog that lost the most weight. Dogs were only included in the study if they were systemically well, euthyroid (based upon measurement of free thyroxine by equilibrium dialysis), and had no significant abnormalities on complete blood (cell) count and serum biochemical analysis. Monthly blood tests were taken to ensure that the dogs remained healthy during the course of the trial. The owners of all participating animals were informed as to the nature of the program, and gave their consent in writing.

Weight-loss regimen

Initially, all patients were weighed using electronic scales, and their body condition scores were determined (19). The dietary allocation for each dog was calculated using computer software (Fit-for-Life™, Royal Canin USA, St. Charles, Missouri, USA). Briefly, estimated target body weight (TBW, expressed in kg) was first calculated using a method based upon initial body weight and body condition score (BCS), where each point on the 5-integer system approximates to 10% excess weight (20). The maintenance energy requirement (MER) for TBW was calculated, based on the formula suggested by the 1974 National Research Council (21):

$$MER = 132 \times TBW^{0.73} \quad \textit{Equation 1}$$

The initial energy allocation given to each dog was a proportion of MER for target body weight, which was determined by both sex and neuter status were (for example, neutered female, entire female, neutered male, and entire males 50%, 55%, 55%, and 60% of MER at estimated target weight, respectively). The chosen diet was a high-protein formula dry diet, designed for feeding during weight loss (ROYAL CANIN Veterinary Diet® CALORIE CONTROL CC32™ HIGH PROTEIN, Royal Canin USA; Table 1). In addition, dogs were allowed only low-calorie treats, such as green beans, or some of their regular food set aside from their daily allotment. In all cases the caloric content of the treats was included in the total daily energy allocation for the dog.

Exercise and lifestyle changes

Throughout the program, dogs undertook regular exercise sessions on an underwater treadmill (Aqua Paws Platinum Underwater Treadmill System; Ferno Veterinary Systems, Wilmington, Ohio, USA), with a surface area of 56 × 147 cm (22 × 58 inches), a speed range of 0.8 to 8.0 km/h (0.5 to 5 mph); the water temperature was set at 27°C to 30°C and the water level set to the height of the elbow. Each dog was exercised at a steady walk for its size and weight; heart rate was monitored to assess response, and both treadmill speed and session duration tailored to the capabilities of the patient.

In addition, all dogs were walked at least once daily, the exact amount depending upon individual capabilities, and attended weekly obedience classes for additional exercise and socialization. To improve client motivation, owners attended weekly educational lectures on pet health topics during the course of the study.

Monitoring

Re-examinations took place at 33, 54, and 86 d. At each visit, a single investigator (AC) weighed all dogs, assigned a BCS, and measured both thoracic and abdominal circumference with a tape measure. Changes were then made to the dietary plan if necessary, in accordance with the computer software used for monitoring. In this respect, the aim was to maintain a rate of weight loss of between 1% to 2% of starting body weight (SBW)/week. If the rate of weight loss dropped below 1% and there was no alternative explanation (such as the owner had fed a significant amount of extra food), the daily energy allocation was decreased by 5% to 10%; if the rate of weight loss exceeded 2% with an alternative explanation (for example, the animal had been anorexic) the daily energy allocation was increased by 5% to 10%.

Data handling and statistical analysis

The equation for maintenance energy requirement (MER in kcal) used in the weight-loss calculations for the current study was:

$$MER = 132 \times BW^{0.73} \quad \textit{Equation 2}$$

based upon the 1974 NRC recommendations (21). However, new recommendations on MER for pet dogs became available after the software had been designed (23). Therefore, to ensure that the results of the study were relevant to the current state of the science, the maintenance energy equation for inactive pet dogs:

$$MER = 95 \times BW^{0.75} \quad \textit{Equation 3}$$

was used instead (23). Accordingly, the results for the energy allocation that the dogs received during weight loss are expressed as percentages of energy requirement at target body weight (ERTBW). Further, weight loss was calculated as a percentage of SBW, rate of weight loss was calculated as a percentage of SBW per week.

A computer software package was used for all statistical analyses (Stats Direct version 2.6.2; Stats Direct, Altrincham, UK). Given that study numbers were small, non-parametric statistical analyses were employed (for example, Friedman's test and Cusick's test for trend). The level of significance was set at $P < 0.05$.

Results

Baseline characteristics of the dogs

Eight dogs were initially enrolled in the study, and details are summarized in Table 2. The Chihuahua was epileptic and on phenobarbital, whilst the American pitbull was suffering from cruciate ligament disease. The remaining dogs had no reported medical conditions.

Outcome of weight loss

Starting energy allocation was 72 ± 5.0% ERTBW and this declined to 58 ± 5.3% ERTBW by the end of the study. The mean energy allocation for the whole period of weight loss was 65 ± 4.5% ERTBW/day. All dogs lost weight during the program, although 2 dogs were withdrawn at the time of first reassessment (33 d), as a result of a decision from the caregivers. Of the remaining 6 dogs, 1 dog completed 2 mo (54 d), whilst the remaining dogs completed 3 mo (86 d). A summary of the weight-loss program is shown in Figure 1. Mean (± standard deviation) percentage of SBW lost was 7.4 ± 2.23%, 10.9 ± 1.88%, and 18.9 ± 5.33%, at 33, 54, and 86 d, respectively, and statistical analysis revealed that weight declined significantly between each revisit ($P < 0.0001$). Mean rate of weight loss for the whole 3 mo was 1.5 ± 0.37%

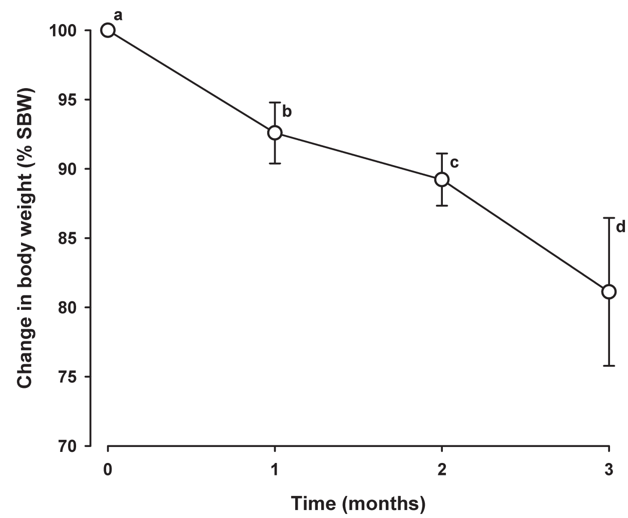

Figure 1. Percentage change in body weight over the course of the program. The symbols represent the mean and bars represent standard deviation for percentage of starting body weight (% SBW) of the dogs at each time point. Points with different letters are significantly different from one another. A significant reduction in body weight was noted at each revisit (Friedman test, $P < 0.0001$).

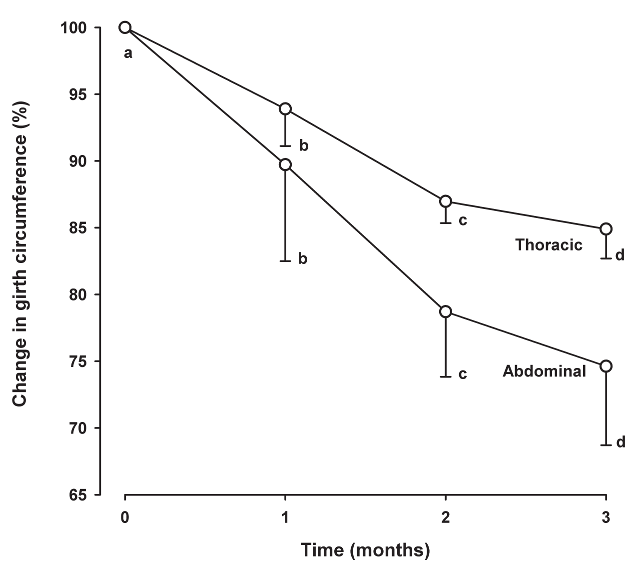

Figure 2. Change in thoracic and abdominal girth measurements over the course of the program. The symbols represent the mean and bars represent standard deviation for percentage of initial girth circumference at each time point. Points with different letters are significantly different from one another. Significant reductions in both thoracic and abdominal girth measurement were noted at each revisit (Friedman test, $P < 0.0001$).

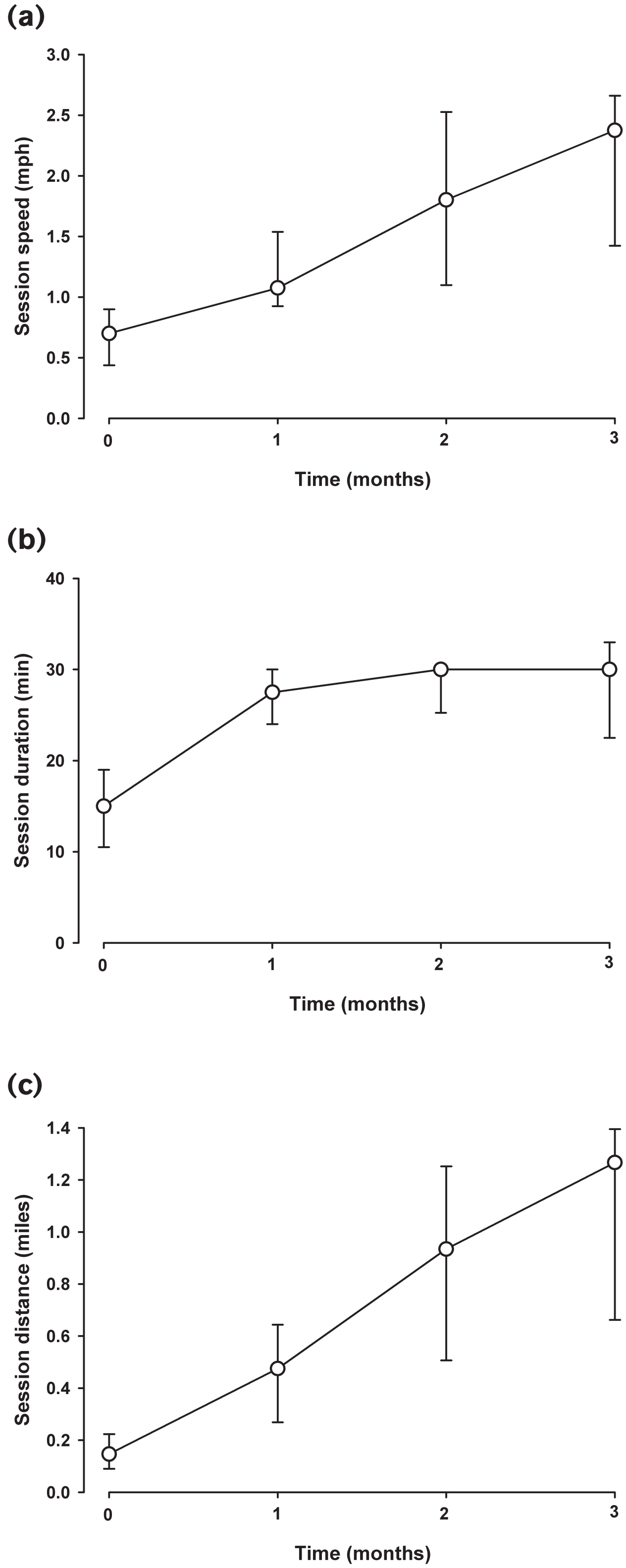

Figure 3. Treadmill exercise levels during the program, represented as (a) session speed in miles per hour (mph), (b) session duration (in min), and (c) total distance travelled (in miles). The symbols represent the median value, whilst the upper and lower bars represent the interquartile range. A significant increase in speed, duration and total distance walked was noted during the course of the study (Cusick's trend test, $P = 0.0023$, $P = 0.0032$, and $P = 0.0010$, respectively).

SBW/week (range: 1.0% to 2.1% SBW/week). Rates of weight loss for each monthly period were 1.6 ± 0.47% SBW/week, 1.0 ± 0.53% SBW/week, and 1.8 ± 0.82% SBW/week in the first, second, and third months of weight loss, respectively, with no significant difference amongst periods (Friedman test, $P = 0.074$). Finally, over the course of the weight-loss program, both thoracic and abdominal girth declined by 15 ± 2.2% and 25 ± 5.9%, respectively, of their initial circumferences ($P < 0.0001$ for both; Figure 2).

Treadmill exercise

The median (range) number of treadmill exercise sessions per dog was 13 (range: 5 to 17). Median session duration was 30 min (range: 8 to 37), median speed was 1.9 km/h (range: 0.3 to 5.6 km/h) (1.2 mph; range: 0.2 to 3.5 mph), and median distance walked was 0.97 km (range: 0.05 to 2.7 km) (0.60 miles; range: 0.03 miles to 1.70 miles). Over the course of the study, the mean session speed ($P = 0.0023$), session duration ($P = 0.0032$), and distance that the dogs were able to travel per session ($P = 0.001$) increased significantly (Figure 3).

Discussion

Most previous weight-loss studies examined the effect of dietary caloric restriction (5–9) and drug therapy (4) and, whilst there have been occasional studies examining lifestyle factors (7,24), this remains an understudied area in canine obesity management. It is noteworthy that the overall rate of weight loss in this study (1.5% SBW/week) was faster than the rates reported in previously published clinical reports using client-owned dogs with naturally occurring obesity. For instance, Saker and Remillard (25) summarized 2 canine weight-loss studies, using a low-calorie diet, with an overall reported rate of weight loss of 0.75%/week (25). In a more recent study, a mean rate of weight loss of 0.85%/week was achieved, using a similar high protein weight-loss diet to the current study with a similar degree of caloric restriction (60% MER at TBW) (9). Furthermore, in clinical trials using dirlotapide for weight loss, an expected weight loss of ∽0.75%/week was reported (4,26).

Thus, the current preliminary results suggest that either including exercise sessions with an underwater treadmill or active client motivation, or both, may improve rate of weight loss. Nonetheless, many limitations exist, most notably the fact that the study was retrospective and did not include a contemporaneous control group for comparison. Making comparisons with the results of historical studies can be unreliable, in that both client and animal populations may vary, there may be differences in diet composition, and in the strategies used for weight management. A second limitation of the study is that it was not possible to determine whether the benefit was the result of the exercise strategy, or client education, or both. Interestingly, a previous trial demonstrated that owner attendance at educational seminars had a limited effect on the outcome of weight loss in dogs (7). These findings may suggest the exercise component was key; however, a prospective, randomized controlled trial would provide more reliable results and, in fact, such a study is currently underway.

All clinical cases received an intensive exercise program, with regular sessions on an underwater treadmill in addition to other activities commonly undertaken in weight-loss programs (such as regular lead walking). Over the course of the study, a gradual increase in exercise capabilities was noted for the dogs, in that session speed, session duration, and total distance walked all increased significantly. As seen in Figure 3, the pattern of response differed for the parameters assessed: session duration increased in the first month of the program, but did not increase thereafter. This may partly relate to the fact that the dogs needed some training before they became completely accustomed to treadmill exercise, but it may also reflect that the session time was limited (up to 30 min). Thus, to increase overall activity further (in terms of distance travelled and hence energy expenditure) session speed would need to increase. In contrast to session duration, more gradual increases in session speed and total distance covered were seen over the course of weight loss. Again, this may partly relate to training and experience with the treadmill. However, given the subjectively gradual nature, other factors may also be involved including the fact that there may have been improvements in fitness levels as the weight program progressed and activity increased.

It is difficult to gauge the effect that the treadmill exercise itself would have had on energy expenditure since this was not directly measured. Energy expenditure during exercise is complex, with greater expenditure occurring with weight-bearing modalities, and with high intensity activity (27). With an underwater treadmill, the reduced joint-loading (due to the buoyancy effect of water) would serve to reduce energy expenditure, but this, however, would be counteracted by water resistance (due to water viscosity), and by altering the treadmill speed to allow the intensity to be varied during a session. Resistance training has been shown to increase resting energy expenditure and increase muscle mass (28), thereby contributing further to energy expenditure by increasing MER. However, the main advantage of using an underwater treadmill is to avoid excessive joint loading, which is helpful for obese animals with orthopedic disease, such as with the American pitbull in the current study.

With respect to exercise, previous studies have demonstrated benefits in human weight-loss programs. First, physical activity can contribute to negative energy balance in patients on caloric restriction, and thus improve the rate of weight loss (10–12). The degree of energy deficiency, however, is minor in relation to the effect of caloric restriction: it is estimated that walking for 5 km/d only increases daily energy requirements by 7% (29). Given that the treadmill exercise that each dog received was not equivalent to such exercise, it is perhaps surprising to note the difference in rate of weight loss. Another possibility is that exercise may affect appetite, as suggested by previous studies (30). A final possibility is that providing more formal exercise may have indirectly improved outcome by improving owner compliance; in this respect, the commitment required to attend regular exercise sessions may improve owner dedication to the program as a whole. This may, in part, be related to the other known effects of increasing exercise, namely that improvements in fitness can be seen even very early on during the weight management regimen; compliance is likely to be better when owners can see rapid benefits in quality of life. Further studies would be required, however, to determine the exact reasons for how exercise improves outcome in weight loss.

In summary, although the findings are preliminary in nature, the results suggest that introducing a formal exercise plan, involving standardized exercise on a treadmill, and active client education may improve the rate of weight loss whilst on a conventional weight-loss regimen. These findings should prompt further studies to determine the optimal strategy for exercise during weight management regimens in dogs.

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Book Review
Compte rendu de livre

Manual of Clinical Procedures in Dogs, Cats, Rabbits, & Rodents

Crow SE, Walshaw SO, Boyle JE. 2009. Wiley-Blackwell. Ames, Iowa, USA, 396 pp. ISBN 9780-8138-1304-2. $71.99.

This book is divided into 4 distinct sections: Part I — Routine Clinical Procedures in Dogs and Cats; Part II — Specialized Clinical Procedures; Part III — Emergency Procedures; and Part IV — Routine Clinical Procedures in Small Mammals. The first section deals with basic material including restraint of dogs and cats, performing nail trims, IV catheter placement, collection and evaluation of ear swabs, skin scrapings and fine-needle aspiration. Other chapters cover somewhat more advanced procedures such as digital rectal examination, urethral catheterization, and ophthalmic procedures. Part II discusses additional techniques commonly encountered in practice, ranging from skin preparation for surgery, intubation, and dental examination, to more advanced, complex procedures such as transtracheal aspiration, peritoneal catheterization and lavage, and cerebrospinal fluid collection. Part III is a relatively short section focusing on medical emergency procedures, including rapid evaluation of bleeding and clotting disorders, blood and plasma transfusion, placement of intraosseous catheters, and tracheostomy. The final section of the book is devoted to basic techniques for rabbits and pocket pets. Procedures covered include restraint, blood collection, IV catheter placement, and medicating via SC and IV injection and per os.

Each chapter is arranged by: Purpose, Complications, Equipment Needed, Restraint and Positioning, and Procedure. Line drawings and diagrams are used frequently and effectively to aid in the description of the equipment, approach to restraint, and practical aspects of the technique. Following some of the procedure descriptions is an added NOTE, which addresses common difficulties and provides additional information. Discussion of related equipment and techniques is included in each chapter where relevant.

This is the 3rd edition of this book. I have not read either of the first two editions and therefore cannot comment on the changes mentioned in the preface, such as the inclusion of ultrasound-guided needle biopsy or laparoscopic biopsy techniques. This book is written clearly and illustrated well. The practical approach including complete supply lists and step-by-step protocols for each procedure make it an excellent resource for new graduates and veterinary technicians in particular. Even though many of the procedures described are familiar, the "attention to indications, contraindications, and preparations should help even the most experienced clinician to select and apply these techniques more appropriately." Veterinarians who handle emergencies will probably want an additional reference with more expansive coverage of critical care procedures, but this book should find wide application in most small animal practices.

Reviewed by ***Altina Wickstrom, DVM, CCRT,*** *Site 905, Box 21, RR 9, Saskatoon, Saskatchewan S7K 1P3.*