

Repeated rhinoscopic and serologic assessment of the effectiveness of intranasally administered clotrimazole for the treatment of nasal aspergillosis in dogs

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Objective—To determine the role of rhinoscopic evaluation and repeated serologic testing in assessing the success rate of intranasally administered clotrimazole for treatment of dogs with nasal aspergillosis.

Design—Prospective case series.

Animals—23 dogs with nasal aspergillosis.

Procedures—Dogs with nasal aspergillosis were treated with an intranasal infusion of 1% clotrimazole solution. Response to treatment was assessed with repeated rhinoscopic evaluation, with histologic examination and fungal culture when available. Results of repeated serologic testing for aspergillosis were monitored throughout the treatment course.

Results—11 of the 23 (48%) dogs had no rhinoscopic evidence of disease after the first treatment. Three of 7 dogs were free of disease after the second treatment, and 1 of 3 dogs was free after the third treatment. Presence or absence of nasal discharge and results of repeated serologic testing were not consistent with disease status. Overall, the efficacy of intranasally administered clotrimazole for treatment of nasal aspergillosis could be confirmed in 15 of 17 dogs. Delayed recurrence or reinfection was confirmed in 3 of 15 dogs. When recurrences were taken into account, the success rate was 67% (12/15 dogs).

Conclusions and Clinical Relevance—Clinical signs were not predictive of disease state, and follow-up rhinoscopy is recommended to assess response to treatment. The success rate of intranasally administered clotrimazole was similar to rates in previous reports; however, the number of dogs with recurrent disease was relatively high. Monitoring of the results of serologic testing is not recommended for use in determining response to treatment. (*J Am Vet Med Assoc* 2010;236:757–762)

Aspergillus spp are saprophytic fungi that are ubiquitous in the environment. Various *Aspergillus* spp can cause disease of the nasal cavity and paranasal sinuses in dogs and, less commonly, systemic infection involving other organ systems.^{1–3} Nasal aspergillosis is usually caused by infection with *Aspergillus fumigatus* and typically affects young to middle-aged dolichocephalic and mesocephalic dogs. Common clinical signs in dogs include chronic nasal discharge, signs of facial pain, and depigmentation with ulceration of the nasal planum.⁴

Antifungal drugs that are administered orally for treatment of affected dogs have included ketoconazole, fluconazole, and itraconazole, with reported efficacy varying from 47% to 100%.^{5–7} Treatments by use of topically applied drugs have included clotrimazole solution,^{8,9} enilconazole solution,^{10,11} and, most recently, a combination of clotrimazole solution and clotrimazole cream.¹² There are no established standards for monitoring response to treatment or

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ABBREVIATION

CT Computed tomography

resolution of disease. Methods of assessment may include clinical evaluation, rhinoscopy, CT, histologic examination, and fungal culture of nasal samples.^{8,13} Additionally, while serologic testing has been found to aid in the diagnosis of nasal aspergillosis in dogs,¹⁴ there is no information on whether the results of serologic testing change with progression or resolution of disease. The objectives of the study reported here were to assess the success rate of intranasally administered clotrimazole for treatment of nasal aspergillosis in dogs by use of follow-up rhinoscopic evaluation, and to determine the usefulness of repeated serologic testing throughout the treatment course.

Materials and Methods

Animals—Twenty-three client-owned dogs in which a diagnostic evaluation of nasal discharge resulted in a diagnosis of aspergillosis at the veterinary teaching hospital of the University of California-Davis between December 2003 and March 2006 were enrolled in the study. All dog owners were asked to sign a consent form prior to inclusion of their dog in the study.

Procedures—All dogs underwent a physical examination, CBC, serum biochemical analysis, rhinoscopy,

and CT of the head to establish the diagnosis of aspergillosis and to confirm the integrity of the cribriform plate. In addition, serologic testing for anti-*Aspergillus* antibodies (23 dogs), procurement of nasal tissue samples for histologic examination (22 dogs), and fungal culture (23 dogs) were performed at the time of diagnosis.

For CT imaging and rhinoscopy, dogs were anesthetized according to individualized protocols determined by the anesthesia department. After premedication and induction, anesthesia was maintained with isoflurane in oxygen. Dogs were monitored throughout by use of pulse oximetry, ECG, and indirect blood pressure monitoring. Computed tomographic images were acquired with a helical CT scanner^a with the patient positioned in sternal recumbency. Rhinoscopy was performed with a 5.0-mm flexible endoscope^b for examination of the caudal nasopharynx and with a 2.8-mm, 0° or 30° view rigid endoscope^c for examination of the rostral nasal cavity. Moist laparotomy pads were placed in the oropharynx to prevent aspiration of any material from the nasal cavity. In all dogs with evidence of sinus involvement on CT images, the frontal sinus was directly examined either by trephination and passage of a rigid endoscope^c into the sinus or by passage of a flexible endoscope^b via the nasofrontal opening, if accessible. Observation of fungal plaques (white, yellow, black, or pale green) on the mucosa of the nasal cavity, frontal sinus, or both was regarded as evidence of fungal infection.⁴

Nasal tissue samples including fungal plaque and adjacent mucosa were obtained via direct observation from both sides of the nasal cavity with a 2- or 3-mm cup biopsy instrument.^d Samples were subsequently submitted for histologic examination and fungal culture. If mucus or blood obscured the nasal cavity during sample collection, cold saline (0.9% NaCl) solution was instilled and suction was applied. Approximately 3 to 5 nasal tissue specimens were obtained from each side of the nasal cavity. Nasal samples for histologic examination were fixed in neutral-buffered 10% formalin, routinely processed, embedded in paraffin, sectioned at a thickness of 4 μ m, stained with H&E, and evaluated by a board-certified pathologist. Evidence supportive of a diagnosis of aspergillosis was identification of septate, branching hyphae and conidia (if present) on the nasal biopsy sample.

Serologic testing for anti-*Aspergillus* antibodies was performed in the immunology laboratory at the veterinary teaching hospital with a commercially available agar gel immunodiffusion test^e as previously described.¹⁴ Serum samples were either submitted immediately for testing or stored for up to 1 month at -20°C. Test results were qualitative and reported as either a positive or negative result for the presence of antibodies against *Aspergillus* spp.

Nasal tissue samples for *Aspergillus* spp culture were placed in a sterile red top tube and transported immediately to the veterinary teaching hospital microbiology laboratory. Fungal culture was performed by use of techniques previously described.¹⁴ Dogs with a diagnosis of nasal aspergillosis were treated immediately following rhinoscopy with a 1-hour intranasally administered infusion of 1% clotrimazole with

a technique described previously.⁸ Débridement of fungal plaques was performed rhinoscopically by use of curettage; saline solution lavage was performed to remove dislodged plaques, blood, and debris. If CT imaging indicated sinus involvement, a trephine hole was created with a Jacob's chuck and a Steinmann pin (4/32 inch) for passage of a rigid endoscope^c with a 0° viewing angle to examine the lateral compartment of the frontal sinus and facilitate débridement.

After extensive débridement of visible fungal material, each dog was repositioned in dorsal recumbency. Pulmonary aspiration of fungal material was prevented by placement of a 24F Foley catheter in the nasopharynx and placement of moistened laparotomy pads in the oropharynx. A 4 X 4-inch gauze pad was placed in the oral cavity over the incisive papilla to prevent leakage of clotrimazole solution into the oral cavity. A 1% clotrimazole solution was prepared by dissolving 1 g of clotrimazole powder^f in 100 mL of polyethylene glycol.^g The treatment solution (50 mL) was administered via 10F polypropylene catheters that were inserted into each nostril and advanced to the level of the ipsilateral medial canthus. Prior to treatment, 12F Foley catheters and cotton-tipped applicators were placed in the nostrils to prevent leakage of the clotrimazole solution. If the frontal sinus was affected and trephination had been performed, a 14F or 16F red rubber catheter was placed through the trephine hole into the frontal sinus and sutured in place with 2-0 nylon. The solution on the ipsilateral side was divided evenly between the frontal sinus and nasal cavity (25 mL each). The head of the dog was rotated from dorsal recumbency to right and then left lateral recumbency, then back to dorsal recumbency at 15-minute intervals for 1 hour. At the end of the treatment, all catheters were removed, and the dog was placed in sternal recumbency with the head tilted downward to allow the clotrimazole solution to drain from the nasal cavity. All residual solution was removed by use of suction. Dogs that had previously commenced treatment with oral administration of antifungal drugs continued this additional treatment, including 3 dogs that were treated with itraconazole, fluconazole, or ketoconazole, respectively, throughout the treatment course.

Response to treatment was based on the results of follow-up rhinoscopic examination. All dogs were scheduled for follow-up rhinoscopy and a second clotrimazole treatment after 1 month, although owner compliance was a factor in completion of follow-up testing. Resolution of disease was documented when fungal plaques were not evident rhinoscopically. Results of follow-up nasal histologic examination, tissue fungal culture, and serologic testing were recorded when available. Dogs in which fungal plaques were not apparent during rhinoscopy and with negative fungal culture results or absence of fungal hyphae histologically were considered treatment successes. Dogs that had fungal plaques present at follow-up rhinoscopy were classified as treatment failures. For these dogs, débridement and clotrimazole treatment were repeated, and a reevaluation including rhinoscopy and clotrimazole treatment was recommended in 1 month. All dogs that had rhinoscopy performed were treated with topically applied

clotrimazole regardless of the presence or absence of visible fungal plaques. Most dogs that had evidence of sinus involvement were re-treated via catheter placed in a trephine hole or, less commonly, via the nasofrontal opening. Dogs that failed to return for a recheck, or that were rechecked but did not undergo rhinoscopy, were classified as lost to follow-up. Additionally, dogs that had a new treatment instituted at the time of the recheck, in conjunction with clotrimazole (ie, indwelling sinus catheter for daily infusions of clotrimazole cream), were also designated as treatment failures, as the purpose of this study was to evaluate the efficacy of topical clotrimazole administration.

Statistical analysis—Data were assessed for normality by use of a Kolmogorov-Smirnov test, and values are presented as mean \pm SD or median and range as applicable. Presence or absence of clinical signs was compared between dogs that responded to treatment and those that did not respond to treatment by use of the Fisher exact test. Statistical analyses were performed with a commercial software package.⁸ Values of $P < 0.05$ were considered significant.

Results

Twenty-three dogs were included in the study over a 28-month period, including 13 castrated males and 10 spayed females. Mean \pm SD body weight was 32.2 ± 10.8 kg (71.0 \pm 23.8 lb). Median age was 7.0 years (range, 1 to 12 years). Clinical signs reported by the owners included nasal discharge (23 [100%] dogs), sneezing (20 [87%] dogs), and epistaxis (11 [48%] dogs). The mean duration of clinical signs was 167 ± 140.7 days. Depigmentation of the nasal planum on physical examination was reported by the attending clinician in 9 (39%) dogs.

Computed tomographic features characteristic of aspergillosis and fungal plaques evident on rhinoscopic examination were present in all 23 (100%) dogs. Evidence of frontal sinus involvement was established in 18 of 23 (78%) dogs based on results of CT and rhinoscopy. All dogs with evidence of sinus involvement on CT scan underwent direct examination of the frontal sinus either via trephination (17/18 dogs) or by nasal passage of a flexible endoscope^b directly into the frontal sinus via the nasofrontal opening (1/18 dogs). Results of this examination agreed with the CT findings in all dogs. There was CT evidence of minor cribriform plate involvement in 2 of 23 (9%) dogs. Specifically, in both dogs, there was a suspected breach in the cribriform plate, with meningeal enhancement in the region of the suspected cribriform breach following contrast administration. Neither dog had abnormal neurologic signs or complications with treatment.

Fungal hyphae were detected on histologic examination of 18 of 22 (82%) samples, and results of serologic testing for aspergillosis were initially positive in 13 of 23 (57%) dogs. Fungal culture of nasal tissue was positive for *A fumigatus* in 22 of 23 (96%) dogs with clinical evidence of aspergillosis.

The first follow-up examination and rhinoscopic evaluation with repeated treatment was performed 1 to 4 months after the first clotrimazole treatment in all 23

dogs. Nasal discharge was reported in 18 of 23 (78%) dogs, sneezing in 19 of 23 (83%) dogs, and epistaxis in 2 of 23 (9%) dogs. All dogs underwent follow-up rhinoscopy regardless of the presence or absence of clinical signs. Fungal plaques were not visible in 11 of 23 (48%) dogs, and these dogs were classified as treatment successes. Seven of these 11 dogs had sinus involvement at the initial rhinoscopy, before treatment. At the first follow-up examination, the affected sinus was assessed by direct observation via the previously placed trephine hole (6/7 dogs) or by nasal passage of the flexible endoscope via the nasofrontal opening (1/7 dogs). Six of these 11 dogs had additional diagnostic tests performed. Three dogs had a negative culture and biopsy, 2 dogs had a negative biopsy with no culture, and 1 dog had a negative culture with no biopsy. Five dogs did not have biopsy or culture repeated.

Persistent fungal disease was found on the basis of rhinoscopic examination in 12 of 23 (52%) dogs, which were classified as having persistent infection. Eleven of 12 (92%) dogs had frontal sinus involvement at the initial exam, before treatment. The sinus was reassessed by visualization through the previously placed trephine hole (8/11 dogs) or passage of the flexible endoscope through the nasal cavity (3/11 dogs). Six of the 12 dogs had additional diagnostics. One dog had a positive biopsy and culture. One dog had a negative culture and positive biopsy. Three dogs had a positive culture with no biopsy, and 1 dog had a positive biopsy with no culture. Six dogs did not have biopsy or culture repeated.

Dogs that responded to the first treatment had nasal discharge (8/11 dogs) and sneezing (7/11 dogs) at a similar proportion as those that did not respond (nasal discharge, 10/12 dogs; sneezing, 11/12 dogs; $P = 0.64$ and 0.16, respectively). There was no significant ($P = 0.16$) difference in the number of dogs with sinus involvement between dogs that responded successfully to treatment and dogs with persistent disease.

Serologic testing was repeated at the first follow-up examination in 12 dogs, including 7 treatment success dogs and 5 dogs with persistent infection. In the treatment-success group, 5 dogs were initially seropositive for antibodies against *Aspergillus* spp, of which 3 remained seropositive and 2 became seronegative. The remaining 2 dogs were initially seronegative and remained seronegative. In the persistent-infection group, 4 dogs were initially seronegative, of which 2 remained seronegative and 2 became seropositive. The remaining dog was initially seropositive for antibodies against *Aspergillus* spp and became seronegative.

Nine of 12 dogs with persistent fungal disease were reevaluated for a third time (second follow-up examination) within 1 to 10 months. Three dogs did not return for a recheck and were classified as lost to follow-up. Clinical signs of nasal disease were present in 8 of 9 dogs. In 2 dogs with moderate nasal discharge, rhinoscopy was declined because of financial concerns. In the remaining 7 dogs that had repeated rhinoscopy, 3 were classified as treatment successes as a result of lack of observable plaques (3/3 dogs) and negative fungal histologic findings and fungal culture results (2/2 dogs). Of 4 dogs with persistent fungal disease at the second follow-up examination, histologic examination

and fungal culture were positive in the 1 dog tested. Dogs that responded to treatment had nasal discharge (2/3 dogs) and sneezing (3/3 dogs) at a similar rate to those that did not respond (nasal discharge, 4/4 dogs; sneezing, 3/4 dogs).

Serologic testing was repeated in 4 dogs at the second follow-up examination. In the treatment-success group, serologic testing was repeated in 2 dogs. One dog was initially seronegative for antibodies against *Aspergillus* spp and remained seronegative. The other dog was initially seronegative but became seropositive for antibodies against *Aspergillus* spp. In the persistent-infection group, serologic testing was repeated in 2 dogs, with 1 dog remaining seronegative and 1 dog remaining seropositive.

All dogs that had rhinoscopy performed at the second follow-up visit (7 dogs) were treated with a third course of topically applied clotrimazole. One dog with persistent fungal infection was also treated by placement of an indwelling tube in the frontal sinus to allow daily administration of clotrimazole for 2 weeks. This dog was subsequently classified as a treatment failure, and no further follow-up information was available.

The remaining 3 dogs with persistent fungal disease were reevaluated a fourth time (third follow-up examination) 1 to 1.75 months after the previous visit. One dog was classified as a treatment success, and 2 dogs had signs of persistent infection. There was resolution of nasal discharge and sneezing in the dog that was classified as a treatment success; however, the remaining 2 dogs had nasal discharge and sneezing, but no epistaxis. None of the dogs underwent repeated tissue fungal culture or histologic examination. One of the dogs with persistent infection underwent repeated serologic testing. This dog was initially seropositive for antibodies against *Aspergillus* spp and remained seropositive.

One of the 2 dogs with evidence of persistent disease was euthanized 2 weeks after the third follow-up examination because of an unrelated heart problem. A necropsy was not performed. The second dog with persistent disease was treated with several courses of treatment with clotrimazole cream in the frontal sinus and was therefore classified as a treatment failure. Repeated rhinoscopy revealed persistent disease, and the dog was euthanized 6 weeks after the last rhinoscopy and clotrimazole treatment because of acute neurologic signs. Necropsy revealed chronic neutrophilic and lymphoplasmacytic meningitis and ventriculitis. Fungal culture of a meningeal swab specimen indicated the presence of *A fumigatus*, although no direct extension of fungal disease could be identified on necropsy examination.

Three dogs had delayed recurrence of aspergillosis throughout the course of treatment. At the time of initial diagnosis, all 3 dogs had involvement of the frontal sinus, and in each patient, sinus trephination had been performed. Two of the recurrences occurred in dogs considered free of disease after the initial clotrimazole treatment, and both dogs had received a second topical infusion at the time of the first follow-up examination. One dog had a recurrence of clinical signs 5 months after successful treatment, and this dog was treated by use of debridement and clotrimazole infusion. Follow-up rhinoscopy revealed persistent fungal infection, and

clotrimazole cream treatment was administered to this dog, which was subsequently lost to follow-up. Initial results of serologic testing in this dog were positive, and this dog remained seropositive for antibodies against *Aspergillus* spp at the time of the recurrence. A second dog had disease recurrence 9 months after the initial successful treatment, and this dog was treated 2 additional times with topically applied clotrimazole. After the second treatment, an indwelling frontal sinus catheter was placed to facilitate daily clotrimazole infusions for 2 weeks. This treatment was deemed successful on the basis of follow-up rhinoscopy 6 months later that revealed the absence of fungal plaques. Initial results of serologic testing of this dog were negative, but the dog was seropositive for antibodies against *Aspergillus* spp at the time of recurrence. The third patient with disease recurrence was the dog that had no rhinoscopic evidence of disease at the third follow-up evaluation. This dog had a recurrence 10 months after successful treatment and was treated with topically applied clotrimazole an additional 2 times, then topical administration of enilconazole (2%) as well as daily treatments of clotrimazole via an indwelling frontal sinus tube. Clinical signs did not resolve, and rhinoscopic evidence of disease resolution was never established. Initial results of serologic testing in this dog were positive and remained positive at the time of recurrence.

Three dogs were treated with itraconazole, fluconazole, or ketoconazole throughout the treatment course. These 3 dogs had been receiving these medications at the time of initial evaluation for 2 months, 2 weeks, and 4 days, respectively. The first 2 dogs had positive fungal culture results at the time of diagnosis. One dog receiving itraconazole was classified as free of disease after 1 clotrimazole treatment. The dog receiving fluconazole was disease free after 3 treatments (ie, at the third follow-up examination) and was 1 of the 3 dogs that had a recurrence. The dog receiving ketoconazole concurrently continued to have clinical signs of infection and was classified as lost to follow-up.

Overall, the efficacy of topically applied clotrimazole was confirmed rhinoscopically in 15 of 17 (88%) dogs; however, follow-up information was not available for the remaining 6 dogs in the study. Treatment successes were obtained after 1 clotrimazole infusion (11 dogs), 2 infusions (3 dogs), and 3 infusions (1 dog). Three of the 15 dogs that were initially classified as treatment successes subsequently developed clinical signs of recurrence or reinfection with *Aspergillus* spp within 5 to 10 months.

Discussion

Eleven of 23 (48%) dogs in the present study were rhinoscopically free of evidence of fungal disease after the first treatment with topically applied clotrimazole. Three of 7 dogs were free of disease after the second treatment, and 1 of 3 dogs was free of disease after the third treatment. Presence or absence of nasal discharge and results of repeated serologic testing were not consistent with disease status. Overall, the efficacy of topically applied clotrimazole could be confirmed in 15 of 17 dogs. Delayed recurrence or reinfection with nasal

aspergillosis occurred in 3 of 15 dogs. When recurrence of disease was taken into account, the success rate was 67% (12/15 dogs). A prior study⁸ revealed a success rate of up to 87% with multiple local infusions of clotrimazole via either trephination or the nares. However, follow-up clinical data consisted of telephone contact with owners or physical examination by the referring veterinarian. Rhinoscopy was not repeated unless clinical signs persisted, and long-term follow-up data were not provided. A second study⁹ that investigated topically applied clotrimazole for treatment of nasal aspergillosis reported an 87% success rate after 1 or 2 treatments with a surgical technique (ie, infusion via trephination). One group was automatically re-treated 4 to 6 weeks after the initial treatment, whereas a second group was only re-treated if clinical signs persisted. Follow-up rhinoscopy was also not performed in this study, and response to treatment was determined by telephone reports. The authors concluded that there was no benefit to a routine second treatment in the absence of clinical signs. In the present study, most dogs had persistent clinical signs after the first clotrimazole treatment, but these were not predictive of disease status based on rhinoscopic assessment.

In a recent clinical report,¹⁵ the recurrence or reinfection with nasal aspergillosis 4 years after resolution of clinical signs in a dog that was treated with a combination of topically applied clotrimazole and oral administration of itraconazole was detailed. Original response to treatment was based on resolution of clinical signs. In the present study, there were 3 patients with recurrence of disease during the study. It is unclear whether the recurrences represented reinfection or recurrence of disease. The 3 recurrences all occurred on the same side of the nasal cavity that was previously affected. Additionally, all 3 dogs had frontal sinus involvement that had been assessed via trephination in each patient. *Aspergillus fumigatus* is ubiquitous in the environment, and factors that contribute to its pathogenesis in certain animals are unknown. Although the recurrences occurred on the side that was previously infected, because destruction of the turbinates had occurred on the originally affected side, it is possible that the originally affected side may be more susceptible to reinfection. Alternatively, it is possible that the recurrences were due to persistent disease, which was not evident on visual inspection during repeated rhinoscopy, particularly in patients with frontal sinus involvement, where destruction of the normal anatomy can make the examination more difficult. Trephination is therefore recommended if the sinus cannot be observed via the nasofrontal opening. Additionally, since all dogs were treated at the time of follow-up rhinoscopy, regardless of disease status, it is also possible that there is emerging resistance to clotrimazole. Fungal sensitivity testing may be indicated to further investigate this. Positive tissue fungal culture results were more common in the present study than in prior reports¹⁴ (96% vs 82%), possibly because of improved visualization and access for sample collection from affected areas.

Three dogs in the present study were concurrently receiving antifungal drugs PO, which had been started prior to the first examination or the commencement

of topically applied clotrimazole treatment. Two of the dogs were classified as treatment successes, although 1 dog developed recurrent disease. It is possible that oral administration of antifungal drugs may have contributed to the 2 successful outcomes; however, both dogs had positive fungal culture results at the time of diagnosis, indicating that the fungus was still present despite treatment with antifungal drugs PO. Additionally, none of the dogs had an improvement in clinical signs after starting the medications, suggesting that the response was more likely to be related to the topically applied clotrimazole.

At the time of diagnosis of nasal aspergillosis, results of serologic testing were positive in 13 of 23 (57%) dogs, which was lower than for prior reports (ie, 67% to 76.5%).^{14,16} Four dogs subsequently became seropositive for antibodies against *Aspergillus* spp throughout the treatment course. If these dogs are taken into account, 74% (17/23) of the dogs in the present study were seropositive, which is similar to the findings in prior reports.^{14,16} Results of follow-up serologic testing did not prove to be a useful indicator of disease status in the present study, as results did not reflect response to treatment. For dogs that responded successfully to treatment, 4 dogs tested positive for the presence of anti-*Aspergillus* antibodies, despite being classified as free of disease, and 3 dogs never became seropositive for antibodies against *Aspergillus* spp throughout the treatment course. Additionally, seroconversion to seropositive status never occurred in 3 dogs with evidence of persistent infection, and 1 dog became seronegative despite persistent disease. Results of serial serologic testing for aspergillosis were unpredictable and therefore do not appear to be clinically useful. Further investigation and serologic testing of dogs with nasal aspergillosis, including dogs with current infection and those with resolution of disease, are suggested.

In the present study, clinical signs were not predictive of response to topically applied clotrimazole for treatment of nasal aspergillosis in dogs. Therefore, repeated rhinoscopy and treatment at monthly intervals are recommended to follow resolution or progression of disease. Because recurrent infection was quite common in the present study, alternative treatments should be investigated further.

- a. Ix/I helical computed tomography scanner, General Electric Medical Instruments, Milwaukee, Wis.
- b. PD20D flexible fiberoptic bronchoscope, Olympus America, Melville, NY.
- c. 0° and 30° rigid telescopes, Endoscopy Support Services, Brewster, NY.
- d. Sontec Instruments, Englewood, Colo.
- e. Meridian Diagnostics Inc, Cincinnati, Ohio.
- f. Spectrum Quality Products, New Brunswick, NJ.
- g. GraphPad Prism, version 5, GraphPad Software Inc, San Diego, Calif.

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From this month's *AJVR*

Comparison of left ventricular contraction profiles among small, medium, and large dogs by use of two-dimensional speckle-tracking echocardiography

Hiroshi Takano et al

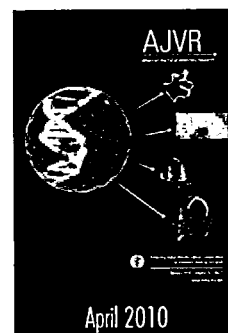
Objective—To assess differences in left ventricular contractile indices among dogs of 3 body sizes via 2-D speckle-tracking echocardiography (STE) and to determine body weight-independent systolic variables.

Animals—37 clinically normal adult dogs.

Procedures—Dogs were allocated into 3 groups on the basis of body weight: small (< 7 kg), medium (7 to 20 kg), and large (> 20 kg). Right parasternal short-axis echocardiographic views were acquired to measure conventional M-mode variables (left ventricular internal diameter at end diastole, left ventricular internal diameter at end systole, and fractional shortening [FS]) and STE indices (peak systolic strain, peak systolic strain rate, synchrony time index [STI], peak systolic apical rotation, peak systolic basal rotation, peak apical twisting rate, and peak systolic torsion). Values were compared among the 3 groups.

Results—STE indices, except for peak systolic radial strain (SRad), peak systolic basal rotation, and STI, were significantly decreased in large dogs, compared with values for small and medium dogs. No significant difference was detected in stroke index, peak systolic SRad, and peak systolic basal rotation among the 3 groups. The STI in large dogs was significantly increased, compared with that of medium dogs.

Conclusions and Clinical Relevance—Results revealed that decreased systolic indices in large dogs should not be interpreted as signs of decreased systolic function. Increased STI in large dogs may contribute to decreased FS. Because peak systolic SRad was not affected by body weight, peak systolic SRad might be a better variable than FS for assessing systolic function. (*Am J Vet Res* 2010;71:421-427)



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