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ORIGINAL ARTICLE

Evaluation of hypochlorous acid as an ear flush in dogs with chronic otitis externa

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Abstract

Background: Chronic otitis externa (OE) in dogs frequently requires anaesthetised ear flushing.

Objectives: To evaluate hypochlorous acid as an ear flushing and antimicrobial agent in dogs with chronic OE.

Animals: Twenty dogs with chronic OE caused by the same organisms bilaterally.

Materials and Methods: One ear was flushed under anaesthesia with hypochlorous acid, the other with saline solution. Subsequently, the ear flushed with hypochlorous acid was cleaned with the same solution twice daily for 2 weeks, the other ear with a commercial ear cleaner. An ear medication containing miconazole, polymyxin B and prednisolone was used once daily in both ears. Clinical scores were determined before the flush. Ear cytological results were obtained, a hearing test was conducted before and after the ear flush, and a culture was taken directly after flushing. Ears were evaluated after 2 weeks of therapy.

Results: Yeast was present in the ears of 11, cocci in one and a mixed infection in eight dogs. Five ears were negative on culture after flushing with hypochlorous acid, one after the saline flush. Clinical and cytological scores decreased significantly with both solutions after 2 weeks of treatment. There was no difference between treatments in any of the scores at any time point between treatments and in the results of the hearing test before and after the flushing procedure. Adverse effects were not seen.

Conclusions and Clinical Relevance: Hypochlorous acid is a suitable cleaning solution for canine OE.

INTRODUCTION

Otitis externa (OE) is one of the most common presenting complaints in small animal practice.[1] It is estimated to affect up to 20% of the canine population.[2,3] While it is not a directly life-threatening condition, long-standing, chronic or recurrent, OE is a very frustrating disease in daily clinical practice and can greatly diminish the quality of life of affected dogs.

Malassezia pachydermatis is a commonly encountered organism causing ear infections in the dog.[4,5] This commensal organism can proliferate under favourable conditions and contribute to chronic OE. *Staphylococcus pseudintermedius* is another common organism identified in canine OE.[6] *Pseudomonas aeruginosa* is a gram-negative, rod-shaped bacterium and can be a problem in dogs with chronic or recurrent bacterial OE.[7]

Hypochlorous acid is a major oxidant produced by neutrophils and is a potent microbicidal agent.[8] It has been shown to be effective in vitro against a number of microbial agents such as *M. pachydermatis*, *Staphylococcus aureus* and *P. aeruginosa*.[9,10] Stabilised hypochlorous acid decreases bacterial growth in

wounds.[11] In addition to its antimicrobial activity, it is able to disrupt biofilm and has favourable effects on keratinocyte migration.[12]

While the antimicrobial activities of hypochlorous acid have been evaluated in vitro in a number of studies, few studies have examined in vivo use of hypochlorous acid for skin disease in dogs.[13,14] Likewise, there are a number of studies describing the in vitro efficacy of several ear medications and cleaners against otic microorganisms.[4,5,15–22] Very few published clinical studies have evaluated in vivo use of hypochlorous acid for the treatment of canine OE, and none of them focuses on the safety and efficacy of hypochlorous acid as an antiseptic during anesthetised ear flush.[23–25] Investigation of in vivo efficacy of antiseptics is warranted as a consequence of increasing multidrug-resistant microorganisms.[26,27] The aim of this study was to evaluate first the antimicrobial efficacy of hypochlorous acid as an ear flushing agent in dogs with OE, and secondly its use as an adjunctive ear cleaner following an ear flush under anaesthesia in these dogs.

MATERIALS AND METHODS

The study was approved by the Ethics Committee of the Faculty of Veterinary Medicine, University of Munich, Germany, under licence 150-29-10-2018.

Study objects and inclusion/exclusion criteria

Dogs with bilateral chronic OE presented for video-otoscopic ear flushes under anaesthesia were included in the study. Chronic OE was defined as otitis clinically present for longer than 3 months or where the current flare was a recurrence of previously diagnosed OE. All dogs underwent preanaesthetic screens, to show normal urea and creatinine values and a normal packed cell volume. Ear canals were required to be wide enough to allow flushing with video otoscopy; this was judged by an otoscopic examination before inclusion. Cytological findings of both ears had to show similar type(s) of organisms with at least a 2+ score of at least one microorganism, bacteria (cocci or rods) and/or *Malassezia* organisms, on a previously validated cytological evaluation scale.[28] Post-inclusion exclusion criteria included masses such as neoplasia or polyps in the ear, or anatomical or inflammatory changes preventing thorough cleaning of the canal and evaluation of the tympani. Underlying diseases were diagnosed with appropriate tests as indicated based on history and clinical examination, yet as each dog served as its own control, different causes of OE were not considered to unduly influence study results.

Study intervention

In each dog, both ears were flushed under general anaesthesia using a video otoscope (Veterinary otoscope; Karl Storz). This video otoscope is equipped with a working channel, through which a red rubber feeding tube (Ernährungssonde 1.5 × 1.1; B. Braun) was inserted under visual control. One ear was flushed with physiological saline solution and the other with a solution containing 0.015% hypochlorous acid and (as inactive ingredients) water, NaCl and phosphate (Vetericyn; Ecuphar). Solutions were warmed before the flushing procedure, and a 30 ml syringe was used to introduce the solution through the port under pressure. Both ear canals were flushed repeatedly until there was no more debris in the lumen of the ear canal or coating the ear canal epithelium and tympanum. Firm particles were removed with a forceps through the working channel. After the ear canal was clean, residual fluid was removed by suction. A flush of the middle ear was planned in case of a ruptured tympanum. Which ear received which flushing solution was determined by a randomisation list created before including the first dog, using a statistical website (https://www.graphpad.com/quickcalcs/randMenu/; Graphpad Software, last accessed 26 April 2021).

After the ear flush, the control ear (previously flushed with saline) was cleaned with a commercial ear cleaner containing aqua, disodium EDTA, PCMX, diethylhexyl sodium sulfosuccinate, salicylic acid, D-rhamnose, glycotechnology (D-galactose, D-mannose, defensin), *Peumus boldus* leaf extract and *Spiraea ulmaria* extract (Epi-Otic; Virbac Tierarzneimittel). Hypochlorous acid (Vetericyn; Ecuphar) was used to clean the treatment ear twice daily, the ear that was previously flushed with the same hypochlorous acid solution. In addition, all dogs received an otic medication containing miconazole, polymyxin B and prednisolone (Surolan, Elanco Animal Health) once daily for 2 weeks.

Clinical, cytological and microbiological assessment

Before anaesthesia, ears were examined and scored according to a previously published system.[29] Briefly, erythema, oedema/swelling, erosion/ulceration and exudate were scored from 0 to 3, the sum of the individual scores resulting in a total score for each ear at each time point.

Cytological samples were obtained from each ear before and after the flush by inserting a swab vertically into the ear canal to the transition from the vertical to the horizontal canal, then turning the swab 360°, removing it and rolling it on a slide. The slide was stained with a modified Wright's stain and evaluated microscopically. It was scanned at ×40 and ×100, and further evaluated at ×400 and ×1,000 as needed using a previously validated cytological score from 0 to 4, the evaluation criteria are listed in Table 1.[28] The sum of the individual values for yeast, rods and cocci formed the total cytological score for that ear at that time point.

Before and after ear flushes, a hearing test was conducted under inhalation anaesthesia. Patients were positioned in sternal recumbency. Three subdermal stainless-steel needle electrodes (disposable six colour

TABLE 1 Classification of the semiquantitative scale used to evaluate cytological specimens[26]

Classification	Description
0	No bacteria/yeast/inflammatory cells
1+	Occasional bacteria/yeast/inflammatory cells present, and slide must be scanned carefully for detection
2+	Bacteria/yeast/inflammatory cells present in low numbers, and detectable rapidly without difficulties
3+	Bacteria/yeast/inflammatory cells present in larger numbers and detectable rapidly without any difficulties
4+	Massive amounts of bacteria/yeast/inflammatory cells present and detectable rapidly without difficulties

subdermal needle electrode, 12 × 0.4 mm; Natus) were placed subcutaneously. The negative (reference) electrode was placed near the mastoid prominence, and the positive (recording) electrode was inserted at the vertex of the cranium. A ground electrode was placed mid-line at the dorsal neck. The right and left ear were evaluated subsequently. Brain auditory evoked potentials were recorded with a Path Medical system. The impedance of each electrode was <10 kΩ and between two electrodes <3 kΩ. Click stimuli were provided by insert earphones (eartips 10 mm or 13 mm diameter; Natus). Alternating stimulation was set at 11 Hz. Hearing threshold was evaluated by starting with 85 dB nHL (normal hearing level) and then reducing the intensity by 10 dB nHL to a minimum of 25 dB nHL. The contralateral ear was masked with a masking noise set at 30 dB below the stimulating noise. The results of 1000 recordings were averaged. Wave amplitude and latencies were marked manually. The tracings were analysed for wave I, II and V latencies and interpeak latency I–V at 80 dB nHL (normal hearing level). Latencies were evaluated as peak latency and measured in milliseconds. Hearing thresholds, defined as stimulus intensity, where wave V is still recordable, were noted in each ear and compared between different treatment groups. Hearing threshold was evaluated by starting with 80 dB nHL and reducing intensity by steps of 10 dB nHL to a minimum of 10 dB nHL.

Cultures were obtained from each side after completion of the ear flush by inserting a swab through a sterile cone into the horizontal part of the ear canal, turning it 360°, removing it and submitting it to the Institute for Infectious Medicine and Zoonoses, Faculty of Veterinary Medicine, LMU, Munich, Germany, for bacterial and fungal culture. Cultures were obtained after the flushing procedure as they were considered more sensitive than cytological results to identify residual organisms after the thorough flushing.

After two weeks, dogs were re-evaluated and otic scores determined for each ear. Ear cytology was evaluated as on Day 0. At that point, the study was completed, although of course dogs received further ear treatment as indicated in each individual case.

Statistical evaluation

Based on pilot data, a mean cytological score of 2+ with a standard deviation of 2 was expected after the two weeks of treatment. We assumed that with 0.012% hypochlorous acid most of the cytological scores would be negative and thus the mean score would be 0.1. Based on this assumption, 17 dogs were needed to detect that difference with a power of 80%.

Primary outcome measures were the number of ear canals negative on culture directly after ear flushing as well as the improvement in otitis and cytological scores from beginning to the end of the study. Secondary outcome measures were the number of ear canals with cytological scores of 0 or 1+ after 2 weeks of treatment, an otic score of ≤3 (considered indicative of clinical success),[29] and the changes in hearing tests before and after flushing.

As each dog received each treatment, each dog served as its own control. The number of ear canals flushed with hypochlorous acid solution and negative on culture were compared with those flushed with physiological saline with a Fisher exact test; the same test was used to compare the number of ear canals in each group with a cytological score of 0 or 1+. The otic and cytological scores before and after treatment as well as the hearing tests before and after flushing were compared with an ANOVA and Dunn post-tests; with data not normally distributed, a Kruskal–Wallis test with an appropriate post-test was chosen (PRISM 9.3; Graphpad Software). A $p < 0.05$ was considered significant for all tests.

RESULTS

Study objects

Twenty dogs were included in the study; signalment of the individual dogs is listed in Table 2. The dogs were 5 ± 3-year-old (range 2–12 years). Twelve of the 20 were allergic and either still undergoing an allergy work-up or owners had refused to perform an elimination diet, three dogs were diagnosed with environmental allergy and one with food allergy. One dog was receiving chemotherapy for haemangiosarcoma, and in three dogs, the underlying disease was not clear.

Clinical assessment

Clinical scores of individual dogs are listed in Table 2. At the beginning of the study, there was no difference in clinical scores between ears treated with hypochlorous acid compared to control ears ($p = 0.932$). In all cases, the flushing procedure was possible, no dog was excluded. The mean exudate scores before the flushing procedure were 2.55 (range 1–3) for the ears flushed with hypochlorous acid and 2.4 (range 1–3) for the ears

flushed with physiological saline solution; those scores were not significantly different ($p = 0.563$). After flushing, the scores on both sides were uniformly 0, as the exudate was removed by the cleaning procedure.

The tympanum was clearly intact in 19 dogs. One dog had foreign bodies (ceruminoliths) in both ears. Those ceruminoliths were removed, and the dog was discharged with a 9:10:1 mixture of clotrimazole, physiological saline and dexamethasone 2 mg/ml for injection as ear treatment, because small defects of the tympanum could not reliably be excluded. Statistical evaluation was performed including and excluding data from this dog with similar results, as the dog was its own control, values including its data are shown. At the re-evaluation after 2 weeks, it became apparent that another dog was treated with ear medication and the control ear cleaner in the left ear, yet the right ear was exclusively treated with hypochlorous acid and no ear medication despite different discharge instructions. This dog had a rod infection in both ears, and cytological and clinical scores did not improve in either ear. Data for the right ear at the re-evaluation were not included in the statistical evaluation.

Significant improvement was seen with both treatments ($p = 0.0006$ for the ears treated with hypochlorous acid, $p = 0.0005$ for control ears); there was no difference between groups (Table 3). After 2 weeks, 13 ears cleaned with hypochlorous acid had a clinical

TABLE 2 Signalment and individual clinical scores of dogs with chronic otitis externa flushed with hypochlorous acid or physiological saline and then treated for 2 weeks with ear medication and hypochlorous acid or control

Number	Age	Breed	Sex	Otic score pre-hypochlorous acid	Otic score post-hypochlorous acid	Otic score pre-control	Otic score post-control
1	12	Beagle	FS	6	2.5	6	1
2	3	Labrador retriever	M	4	2	6	3
3	4	Labrador retriever	MC	5	2	5	3
4	4	Swiss mountain dog	FS	3	3	2	1
5[a]	3	Poodle	M	5	6	4	4
6	7	Mixed breed	FS	4	4.5	5	3.5
7	7	German shepherd dog	M	6	3.5	10	5.5
8	8	Mixed breed	FS	4	2	3.5	2
9	4	Golden retriever	M	4	5	4	4
10	2	Bassett hound	MC	5	3	5	3
11	5	Mixed breed	M	7.5	2	7	4
12	7	Labrador retriever	F	7	3	7	8
13	5	Labrador retriever	FS	3	0	3	1
14	2	Golden retriever	FS	5	1	4	3
15	2	Vizsla	F	7	2	7	2
16	12	Jack Russell terrier	FS	2	2	2	2
17	4	Mixed breed	FS	4	0	4	0
18	2	Dogo Argentino	FS	8	5	7	0
19	12	Spanish water dog	M	6	4	6	4
20	3	Staffordshire terrier	F	6	4	6	4

Abbreviations: F, female; FS, female spayed; M, male; MC, male castrated.
[a]This dog had received the prescribed ear medication and control flush in the left ear, and the right ear was treated only with Vetericyn during the 2 weeks.

TABLE 3 Otic scores of dogs with chronic otitis cleaned with hypochlorous acid versus control

	Cleaning with			
	Hypochlorous acid		Control	
	Pre-treatment	Post-treatment	Pre-treatment	Post-treatment
Mean otic scores	5.1	2.8[a]	5.2	2.9[a]
Standard deviation	1.6	1.6	2.0	1.9
Range	2–8	0–6	2–10	0–8
Median otic scores	5.0	2.75	5.0	3.0
25–75th percentile	4–6	2–4	4–6.75	1.25–4

[a]Significant difference to baseline.

score of ≤3 and 12 ears treated with saline improved to ≤3.

Cytological assessment

Eleven dogs showed a pure yeast infection, one an infection with cocci and eight a mixed infection with either yeast and cocci (n = 1), yeast and rods (n = 1), cocci and rods (n = 3) or all three organisms (n = 3). Neutrophils were seen in the ears of six dogs.

There was no significant difference regarding cytological scores (Table 4) between groups at the beginning or the end of the study ($p > 0.999$ for both), yet cytological scores improved significantly for ears flushed with hypochlorous acid (p = 0.005) as well as with the control treatment (p = 0.003). At study end, dogs treated with hypochlorous acid and ear medication improved significantly compared to baseline ($p < 0.0001$) as did the dogs in the control group ($p < 0.0001$). After treatment, 17 and 16 of the ears showed a cytological score of 0 or 1+, respectively. Cytological scores for individual dogs are listed in Table S1.

Microbiological assessment

Malassezia pachydermatis (n = 17), *S. pseudintermedius* (n = 12), *P. aeruginosa* (n = 6), *Corynebacterium auriscanis* (n = 5), *Streptococcus canis* (n = 3), *Escherichia coli* (n = 2), *Staphylococcus schleifferi* (n = 2) and *Bacillus* spp. (n = 1) were cultured from 34 ears alone or in various combinations. In one dog, only a bacterial culture was conducted by the laboratory despite the request for bacterial and fungal culture; this dog had negative bacterial cultures and yeast infections in both ears based on cytological results. Five of the 19 ears flushed with hypochlorous acid were negative on culture after the procedure, while only one of the control ears was negative, a difference that was not significant (p = 0.182). All of those ears with negative culture results still showed organisms on cytological evaluation; however, the cytological score was >1 in only two of those ears, both of those ears had yeast organisms on cytological evaluation. When cultures were positive, the culture results correlated perfectly with the cytological findings in 19 ears (in most cases again with a cytological score of 1). In seven further ears, not all organisms cultured were identified on cytological evaluation and in six ears the organisms cultured did not correlate with the cytological results because either *S. pseudintermedius* was cultured and a few yeasts were seen on cytological evaluation (n = 4) or cytological score was negative with positive cultures of *P. aeruginosa* (n = 1) and *S. pseudintermedius* (n = 1).

Results of hearing thresholds

There was no difference between the results of the hearing tests between groups before (p = 0.8911) and after (p = 0.9979) flushing or in each group before and after flushing (p = 0.9901 for dogs flushed with hypochlorous acid and p = 0.9998 for dogs flushed with saline solution). The median threshold was at 55 dB nHL before and after flushes (range 25–85 dB nHL; mean threshold before flush 56.24 dB nHL and after flush 55.81 dB nHL). Mean and median latencies for waves I, II and V, as well as interpeak latencies I–V (ms) are given in Table 5.

TABLE 4 Cytological scores of dogs with chronic otitis cleaned with hypochlorous acid versus control

	Cleaning with					
	Hypochlorous acid			Control		
	Pre-flush	Post-flush	Study end	Pre-flush	Post-flush	Study end
Mean cytological scores	3.7	1.7[a]	0.9[a]	3.2	1.5[a]	1.1[a]
Standard deviation	1.7	1.0	1.0	1.2	1.0	1.1
Median cytological scores	3.5	1	1	3	1	1
25–75th percentile	2–7	1–2.5	0–1	2–4	1–2.625	0–1

[a]Significant difference to baseline.

TABLE 5 Mean and median latencies for waves I, II and V, as well as interpeak latencies I–V (ms) of hearing tests before and after ear flushes in dogs with chronic otitis externa

	Wave I latency (ms)		Wave II latency (ms)		Wave V latency (ms)		Interpeak latencies I–V (ms)	
	Pre-flush	Post-flush	Pre-flush	Post-flush	Pre-flush	Post-flush	Pre-flush	Post-flush
Median	1.3	1.5	2.1	2.4	3.9	4.05	2.6	2.55
Mean	1.43	1.61	2.21	2.51	3.90	4.13	2.48	2.52
Reference[a]	1.28 ± 0.01		2.09 ± 0.03		3.85 ± 0.08		2.57 ± 0.08	

[a]From Cuddon PA. Electrodiagnosis in veterinary neurology. Electromyography, nerve conduction studies, and evoked potentials. Loveland, CO: Veterinary Specialists of Northern Colorado, 2000.

DISCUSSION

In this study, ear flushing under anaesthesia with hypochlorous acid and the subsequent use of this product as an ear cleaner was as effective as traditional treatment and did not lead to any adverse effects.

In most of the dogs in this study, ear canals were infected with *M. pachydermatis*. This is a common organism involved in chronic canine OE.[30–32] Drug resistance against commonly used antifungal organisms such as azoles or nystatin, although rare, has been reported.[33,34] A mixed infection also was seen frequently, as reported in other studies.[32,35,36] Labrador and Golden retrievers were the most common breeds in this study, as seen in other studies[24,30,35,36] This is not surprising because OE is a frequent clinical sign of atopic dermatitis and both breeds are predisposed to this disease.[37,38] It has been shown that allergies are one of the most common skin complaints in small animal practice in Germany and our findings correspond to this.[39]

In another study, one quarter of dogs with acute OE subsequently had one or more recurrences of OE.[40] Almost all of the dogs with chronic OE included in this study had an intact tympanum; only in one dog was the integrity of the tympanum questionable. This is in contrast to another study where the tympanum was ruptured in close to a third of the dogs with chronic OE.[5] Possible reasons for the differing results are different dog populations and breeds on different continents, a longer duration of the OE and the higher proportion of dogs with *P. aeroginosa* in the latter study.[5]

A significant improvement with treatment was seen cytologically and clinically in all dogs included in this study. This corresponds to other published studies evaluating a variety of ear medications and cleaners.[25,35,36,41–44] However, only one of the dogs was completely normal on otoscopic examination after treatment. With chronic OE, the hyperplastic changes of epithelium and ceruminous and sebaceous glands may take longer than the treatment period of 2 weeks in our study. In other studies, clinical and cytological scores of individual patients were not provided and the main outcome measure was improvement in mean clinical scores.[24,36,41,43] Similar improvement also was seen in our study. The dogs' primary diseases and OE were further treated as appropriate after study completion, yet 2 weeks were deemed sufficient to identify significant differences between the control ear cleaner and hypochlorous acid.

Cultures obtained directly after the ear flush were negative in a quarter of the ears flushed with hypochlorous acid and in only one ear flushed with saline solution. This confirms the antiseptic properties of the hypochlorous acid formulation although the difference in the number of negative cultures between flushing agents was not statistically significant. Only three dogs were cytologically completely negative after 2 weeks of treatment. This is in concordance with the few studies that have evaluated ear canals cytologically after treatment[25,41,45] and probably explained by a re-colonisation from the skin at the entrance of the canal and the differences in controlling the underlying diseases. Culture and cytological results did not always correlate, and in general organisms found on culture were not present on cytological evaluation. This is not surprising because the ears were cleaned thoroughly and consequently not much debris could be sampled for cytological evaluation. However, a culture will identify even very small numbers of bacteria that are easily missed with cytological sampling.

There are several limitations to this study. Ideally, all dogs included should have the same underlying disease and this disease should be treated in an identical fashion in all dogs. Inclusion could be limited to dogs with atopic OE owing to environmental allergies, probably the most common cause of chronic otitis. This approach is hampered by differing severity of disease in individual patients, different response of individual patients to various medications, and financial and emotional constraints of the owners. The influence of patient-specific factors was minimised, as each dog served as its own control. A longer treatment duration of one or two months could possibly show different results. Although the use of ear medications and ear cleaners was explained to all owners in great detail and a link to a YouTube video demonstrating the correct use of an ear flush was provided, compliance and cleaning technique of different owners may be different. Treatment of all dogs by the same person would be preferable. However, as with the differences in underlying diseases the influence was minimised by the fact that each dog served as its own control and both ears in each dog were treated by the same person. Finally, a higher concentration of hypochlorous acid may be more effective than saline.

In conclusion, flushing the ears under anaesthesia with hypochlorous acid and using this agent as an ear cleaner in combination with commercial ear medications for canine chronic OE was effective and safe. Adverse effects were not seen in any of the dogs in this study.

AUTHOR CONTRIBUTIONS

Ralf S Mueller: Conceptualization; data curation; formal analysis; funding acquisition; investigation; methodology; project administration; resources; software; supervision; validation; visualization; writing – original draft; writing – review and editing. **Katja Baumann:** Data curation; investigation; project administration; writing – original draft. **Teresa Boehm:** Data curation; investigation; project administration; writing – original draft. **Stefanie Doerfelt:** Data curation; formal analysis; investigation; methodology; validation; writing – original draft. **Bettina Kasper:** Data curation; investigation; project administration; visualization; writing – original draft. **Laura Udraite-Vovk:** Data curation; investigation; project administration; writing – original draft.

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SUPPORTING INFORMATION

Additional supporting information can be found online in the Supporting Information section at the end of this article.

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Résumé

Contexte: L'otite externe (OE) chronique chez le chien nécessite fréquemment un rinçage des oreilles sous anesthésie.
Objectifs: Évaluer l'acide hypochloreux en tant qu'agent antimicrobien et de rinçage des oreilles chez les chiens atteints d'OE chronique.
Animaux: Vingt chiens atteints d'OE chronique causée par les mêmes organismes bilatéralement.
Matériels et méthodes: Une oreille a été rincée sous anesthésie avec de l'acide hypochloreux, l'autre avec une solution saline. Par la suite, l'oreille rincée à l'acide hypochloreux a été nettoyée avec la même solution deux fois par jour pendant deux semaines, l'autre oreille avec un nettoyant pour oreilles commercial. Un médicament pour les oreilles contenant du miconazole, de la polymyxine B et de la prednisolone a été utilisé une fois par jour dans les deux oreilles. Les scores cliniques ont été déterminés avant le rinçage. Les résultats cytologiques de l'oreille ont été obtenus, un test auditif a été effectué avant et après le rinçage de l'oreille et une culture a été prise directement après le rinçage. Les oreilles ont été évaluées après deux semaines de traitement.
Résultats: Des levures étaient présentes dans les oreilles de 11 chiens, des cocci chez un et une infection mixte chez huit chiens. Cinq oreilles étaient négatives à la culture après rinçage à l'acide hypochloreux, une après le rinçage salin. Les scores cliniques et cytologiques ont diminué significativement avec les deux solutions après deux semaines de traitement. Il n'y avait aucune différence entre les traitements dans aucun des scores à aucun moment entre les traitements et dans les résultats du test auditif avant et après la procédure de rinçage. Aucun effet indésirable n'a été observé.
Conclusion et pertinence clinique: L'acide hypochloreux est une solution de nettoyage appropriée pour l'OE canine.

Resumen

Introducción: La otitis externa crónica (OE) en perros requiere con frecuencia un enjuague de oídos bajo anestesia.
Objetivos: Evaluar el ácido hipocloroso como agente antimicrobiano y enjuague de oídos en perros con OE crónica.
Animales: Veinte perros con OE crónica causada por los mismos organismos de forma bilateral.
Materiales y Métodos: Se enjuagó un oído bajo anestesia con ácido hipocloroso, el otro con solución salina. Posteriormente, el oído enjuagado con ácido hipocloroso se limpió con la misma solución dos veces al día durante dos semanas, el otro oído con un limpiador de oídos comercial. Se utilizó un medicamento para los oídos que contenía miconazol, polimixina B y prednisolona una vez al día en ambos oídos. Las puntuaciones clínicas se determinaron antes del lavado. Se obtuvieron resultados citológicos del oído, se realizó una prueba de audición antes y después del lavado del oído y se tomó un cultivo directamente después del lavado. Las orejas se evaluaron después de dos semanas de terapia.

Resultados: se observaron levaduras en los oídos de 11 perros, cocos en uno y una infección mixta en ocho perros. Cinco oídos dieron negativo en el cultivo después del lavado con ácido hipocloroso, uno después del lavado con solución salina. Las puntuaciones clínicas y citológicas disminuyeron significativamente con ambas soluciones después de dos semanas de tratamiento. No hubo diferencia entre tratamientos en ninguna de las puntuaciones en ningún momento entre tratamientos y en los resultados de la prueba de audición antes y después del procedimiento de lavado. No se observaron efectos adversos.
Conclusión y relevancia clínica: El ácido hipocloroso es una solución limpiadora adecuada para la OE canino.

Zusammenfassung
Hintergrund: Bei einer chronischen Otitis externa (OE) benötigen Hunde häufig eine Ohrspülung in Narkose.
Ziele: Die Evaluierung hypochloriger Säure als Ohrreiniger und antimikrobiellem Wirkstoff bei Hunden mit chronischer OE.
Tiere: Zwanzig Hunde mit chronischer OE, die bilateral von denselben Organismen verursacht wurden.
Materialien und Methoden: Ein Ohr wurde unter Narkose mit hypochloriger Säure, das andere mit Kochsalzlösung gespült. In der Folge wurde das Ohr, welches mit hypochloriger Säure gespült worden war, mit derselben Lösung zweimal täglich zwei Wochen lang gereinigt, das andere Ohr wurde mit einem kommerziellen Ohrreiniger gereinigt. Eine Ohrmedikation bestehend aus Mikonazol, Polymyxin B und Prednisolon wurde einmal täglich in beiden Ohren angewendet. Die klinischen Werte wurden vor der Spülung erhoben. Es wurde eine Ohrzytologie gemacht, ein Hörtest vor und nach der Spülung erhoben, sowie eine Kultur angelegt, die direkt nach der Spülung gewonnen wurde. Die Ohren wurden nach einer zweiwöchigen Therapie evaluiert.
Ergebnisse: Hefepilze traten in 11 Ohren, Kokken in einem und eine gemischte Infektion bei acht Hunden auf. Fünf Ohren hatten eine Negativkultur nach der Spülung mit hypochloriger Säure, eines war negativ nach der Spülung mit Kochsalzlösung. Klinische und zytologische Werte nahmen bei beiden Lösungen nach einer zwei-wöchigen Behandlung signifikant ab. Es bestand zu keinem Zeitpunkt ein Unterschied zwischen den Behandlungen und den Ergebnissen der Hörtests vor und nach der Spülung. Es wurden keine Nebenwirkungen gesehen.
Schlussfolgerung und klinische Bedeutung: hypochlorige Säure ist eine passende Reinigungslösung für die canine OE.

要約
背景: 犬の慢性外耳炎(OE)には麻酔下での耳洗浄が必要となることが多い。
目的:　本研究の目的は、慢性外耳炎を有する犬において、次亜塩素酸を耳洗浄剤および抗菌剤として評価することであった。
対象動物: 同一菌による両側性慢性OEを持つ犬20頭。
材料と方法:　片耳は麻酔下で次亜塩素酸によって、もう片方は生理食塩水で洗浄した。その後、次亜塩素酸で洗浄した耳は同液で1日2回、2週間洗浄し、もう片方の耳は市販のイヤークリーナーで洗浄した。ミコナゾール、ポリミキシンB、プレドニゾロン含有点耳薬を1日1回両耳に使用した。洗浄前に臨床的スコアを決定した。耳の細胞診の結果、耳洗浄の前後に聴力検査を実施し、耳洗浄後に培養検査を直接行った。耳は2週間の治療後に評価した。
結果: 11頭の耳に酵母、1頭に球菌、8頭に混合感染を認めた。次亜塩素酸による洗浄後5耳、生理食塩水による洗浄後1耳は培養陰性であった。治療開始2週間後、いずれの溶液でも臨床的および細胞学的スコアは有意に減少した。治療間のどの時点でも、また洗浄処置前後の聴力検査の結果でも、いずれのスコアにも治療間の差はなかった。また、有害事象も認めなかった。
結論と臨床的関連性: 次亜塩素酸は犬の OE に適した洗浄液である。

摘要
背景: 犬的慢性外耳炎 (OE) 经常需要麻醉后耳道冲洗。
目的: 评价次氯酸作为慢性OE犬的耳道灌洗液和抗菌剂的使用效果。
动物: 20只患有双侧相同微生物引起的慢性OE犬。
材料和方法:麻醉后一侧耳道用次氯酸冲洗 , 另一侧用生理盐水冲洗。随后 , 用次氯酸冲洗的耳道仍用相同溶液清洗 , 每日两次 , 持续两周 , 另一侧耳道用市售耳清洁剂清洁。双耳使用含有咪康唑、多粘菌素 B 和泼尼松龙的耳药 , 每日一次。在冲洗前确定临床评分。记录耳细胞学结果 , 在耳冲洗前后进行听力测试 , 冲洗后直接采集分泌物培养。治疗两周后评价耳道。

Resumo
Contexto: Otite externa (OE) crônica em cães frequentemente requer lavagem ótica sob anestesia.
Objetivo: Avaliar o ácido hipocloroso como um limpador de orelhas e agente antimicrobiano em cães com OE crônica.
Animais: Vinte cães com OE crônica causada pelos mesmos microrganismos bilateralmente.
Materiais e métodos: Uma orelha foi lavada sob anestesia com ácido hipocloroso e a outra com solução salina. Subsequentemente, a orelha lavada com ácido hipocloroso foi lavada com a mesma solução duas vezes ao dia por duas semanas, a outra orelha foi lavada com um limpador comercial. Uma fórmula otológica contendo miconazol, polimixina B e prednisolona foi utilizada uma vez ao dia em ambas as orelhas. Escores clínicos foram mensurados antes da lavagem. Citologias otológicas foram coletadas, teste de audição foi realizado antes e depois da

lavagem, cultura e antibiograma foi coletada logo após a lavagem. As orelhas foram avaliadas após duas semanas de tratamento.
Resultados: Leveduras estavam presentes nas orelhas de 11, cocos em um e infecção mista em oito cães. Cinco cães foram negativos na cultura após a lavagem com ácido hipocloroso e um após a lavagem com salina. Os escores clínicos e citológicos reduziram bastante com ambas as soluções, após duas semanas de tratamento. Não houve diferença entre os tratamentos em nenhum escore e qualquer tempo entre tratamentos e nos resultados dos testes de audição antes e depois da lavagem. Não foram observados efeitos colaterais.
Conclusão e importância clínica: O ácido hipocloroso é uma solução de limpeza adequada para OE canina