The Thai Journal of Veterinary Medicine

Volume 42
Issue 3 *September, 2012*

Article 5

9-1-2012

Side Effects in 412 Dogs from Swimming in a Chlorinated Swimming Pool

Korakot Nganvongpanit

Terdsak Yano

Original Article

Side Effects in 412 Dogs from Swimming in a Chlorinated Swimming Pool

Korakot Nganvongpanit[1*] Terdsak Yano[2]

Abstract

This study reports the side effects in dogs from swimming in a chlorinated swimming pool. Data were collected from September 2008 until April 2012. A total of 412 dogs (male= 219 and female= 193), aged 38±30 months, served as the subjects. The dogs were divided into four groups based on the aims of swimming: entertainment (n= 152), weight reduction (n= 53), rehabilitation after orthopedic surgery (n= 81), and rehabilitation for muscle and joint disease (n= 126). The data were recorded for five separate swimming times. At first, some dogs (29.13%) showed overexcitement and/or fear, but this percentage decreased with increased swimming frequency. Some dogs (36.51%) were not able to swim, and required a trainer. The main side effects from the 1st swimming time included dry hair (20.63%), dry skin (18.93%), and abrasion wounds at the armpits (15.78%); these effects increased with increased frequency of swimming. Other side effects were red eyes (13.59%), otitis (6.31%), and a small number of respiratory problems (0.49%). In conclusion, data from this study can be used by veterinarians to inform pet owners about the potential side effects from swimming in chlorinated swimming pools.

Keywords: dog, side effects, swimming

[1]*Bone and Joint Research Laboratory, Department of Veterinary Biomedical Science and Public Health, Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai 50100, Thailand*
[2]*Department of Food Animals, Faculty of Veterinary Medicine, Chiang Mai University, Chiang Mai 50100, Thailand*
***Corresponding author: E-mail:** korakot.n@cmu.ac.th; korakot_n@hotmail.com*

บทคัดย่อ

ผลข้างเคียงจากการว่ายน้ำในสระน้ำระบบคลอรีนของสุนัข 412 ตัว

กรกฎ งานวงศ์พาณิชย์ [1*] *เทิดศักดิ์ ญาโน* [2]

การศึกษาครั้งนี้รายงานผลข้างเคียงจากการว่ายน้ำของสุนัขในสระที่เป็นระบบคลอรีน เก็บข้อมูลตั้งแต่เดือนกันยายน พ.ศ. 2551 ถึงเดือนเมษายน พ.ศ. 2555 สุนัขจำนวน 412 ตัว (เพศผู้ 219 ตัวและเพศเมีย 193 ตัว) อายุเฉลี่ย 38±30 เดือน สามารถแบ่งสุนัขตามวัตถุประสงค์การว่ายน้ำได้เป็น 4 กลุ่ม เพื่อนันทนาการ (152 ตัว) ลดน้ำหนัก (53 ตัว) กายภาพบำบัดหลังการผ่าตัดทางออร์โธปิดิกส์ (81 ตัว) และ กายภาพบำบัดเพื่อฟื้นฟูกล้ามเนื้อและข้อต่อ (126 ตัว) ทำการเก็บข้อมูลสุนัขที่มาว่ายน้ำ 1 ถึง 5 ครั้ง พบว่าในครั้งแรกที่สุนัขมาว่ายน้ำมีอาการตื่นเต้นและกลัว (ร้อยละ 29.13) แต่อาการนี้จะลดลงเมื่อมาว่ายน้ำบ่อยขึ้น พบว่ามีสุนัขบางตัว (ร้อยละ 36.51) ไม่สามารถว่ายน้ำได้ต้องอาศัยผู้ช่วย ผลข้างเคียงหลักที่พบหลังมาว่ายน้ำในครั้งแรกคือ ขนแห้ง (ร้อยละ 20.63) ผิวหนังแห้ง (ร้อยละ 18.93) และแผลถลอกบริเวณโคนขาหนีบด้านใน (ร้อยละ 15.78) โดยพบผลข้างเคียงนี้เพิ่มขึ้นเมื่อว่ายน้ำบ่อยขึ้น สำหรับผลข้างเคียงอื่นที่พบ ได้แก่ ตาแดง (ร้อยละ 13.59) หูอักเสบ (ร้อยละ 6.31) และโรคระบบทางเดินหายใจ (ร้อยละ 0.49) สัตวแพทย์สามารถนำผลไปให้ข้อมูลแก่เจ้าของสุนัขถึงผลข้างเคียงที่อาจเกิดขึ้นจากการว่ายน้ำในสระน้ำระบบคลอรีน

คำสำคัญ: สุนัข ผลข้างเคียง ว่ายน้ำ

[1] *ห้องปฏิบัติการวิจัยโรคกระดูกและข้อในสัตว์ ภาควิชาชีวศาสตร์ทางสัตวแพทย์และสัตวแพทย์สาธารณสุข คณะสัตวแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ อ. เมือง จ. เชียงใหม่ 50100*

[2] *ภาควิชาสัตว์บริโภค คณะสัตวแพทยศาสตร์ มหาวิทยาลัยเชียงใหม่ อ. เมือง จ. เชียงใหม่ 50100*

***ผู้รับผิดชอบบทความ E-mail:** korakot.n@cmu.ac.th; korakot_n@hotmail.com*

Introduction

Swimming has become an increasingly popular activity for small animals. The objectives of swimming can be grouped into two general categories: for entertainment, and for physical rehabilitation. The advantages of swimming are similar for both small animals and humans. This activity involves almost all major muscle groups, and places a vigorous demand on the heart and lungs. It is superior to any training machine which usually exercises only one group of muscles.

As in the case of human rehabilitation, application of aquatic exercise can result in reduced weight, recovery of muscle mass and function, improved range of motion, and prevention of joint stiffness. The buoyancy, hydrostatic pressure, viscosity, resistance, and surface tension of water increase the efficacy of the exercise (Edlich et al., 1987). These properties of water have a positive effect, resulting in increased muscle mass, strength and endurance, as well as decreased pain during movement (Wang et al., 2007; Silva et al., 2008). Water buoyancy significantly decreases contact force and stress on weight-bearing joints, bones and muscles, which in turn reduces pain (Bartels et al., 2007). Water properties can not only improve muscle strength, but also prevent hyperthermia during exercise (Nganvongpanit and Kongsawasdi, 2008).

Although several studies in dogs have demonstrated the advantages of swimming (Weisgerber et al., 2003; Tanaka, 2009; Meredith-Jones et al., 2011), the side effects in dogs from swimming in chlorinated swimming pools have not yet been reported. The results of this study will assist veterinarians in designing swimming programs for dogs and providing information to pet owners about the potential side effects of swimming in chlorinated swimming pools.

Materials and Methods

Animals: Data were collected over a four-year period, from September 2008 until April 2012. The study involved a total of 412 dogs (male= 219 and female= 193) aged 38±30 months; 233 dogs swam with swimsuits, while the other 189 dogs swam without swimsuits. Data concerning dogs that participated in the study is shown in Table 1.

Swimming pool: The swimming pool (2.5x6.0x1.5 m, WxLxH) in this study was a chlorine system using calcium hypochlorite, a long-lasting chlorine (J.D. Pools, Thailand). During the day, water temperature ranged between 30-35^{0}C, pH between 7.2-8.4, and chlorine level 0.5-2.0 ppm.

Table 1 Data of all dogs used in the study.

Breed	Number	Male	Female	Age (months)	Weight (kg)
Small breed					
Shih Tzu	34	14	20	45±34	7.74±2.86
Poodle	28	8	20	44±32	2.95±0.94
Chihuahua	34	21	13	53±25	2.45±0.86
Pomeranian	31	19	12	42±31	4.03±0.92
Yorkshire Terrier	11	5	6	57±38	2.18±0.63
Jack Russell Terrier	19	11	8	50±30	8.84±1.70
Pug	35	14	21	45±22	9.77±1.67
Beagle	4	1	3	38±22	8.78±1.47
French Bulldog	4	3	1	10±1	9.30±0.71
Miniature Pinscher	19	10	9	50±25	2.86±0.86
Medium breed					
Thai Bangkaew	5	4	1	27±8	19.00±1.59
Bull Terrier	1	1	-	7	16
Crossbreed	33	18	15	44±37	21.39 ± 6.65
Cocker Spaniel	4	3	1	32±9	22.38 ± 2.14
Large breed					
Golden Retriever	53	32	21	42±27	41.12±7.52
Labrador Retriever	39	17	22	36±29	32.33±43.00
Siberian Husky	22	15	7	46±27	26.26±6.53
St. Bernard	2	1	1	9±4	49.00±4.24
German Shepherd	18	6	12	42±32	34.14±5.93
Samoyed	1	-	1	5	21
American Pit Bull Terrier	25	20	5	51±29	39.00±8.60
Total	**412**	**219**	**193**	**36±30**	**-**

Data collection: Data were recorded by veterinarians, and included whether the dog was able to swim the first time (with or without swimsuit), as well as physical signs: the presence of an abrasion wound at the armpit (with or without swimsuit), dry hair, dry skin, red eye, otitis, or respiratory disorder. Data were recorded for 5 consecutive swimming times, with intervals in between of no longer than 5 days. The number of animals in each category was calculated as a percentage.

Statistical analysis: Number of the dogs that presented abrasion wounds at the armpits (with or without swimsuits), dry hair, dry skin, red eyes, otitis or respiratory disorders was compared among 5 consecutive swimming times by Chi-square test. In order to study the dogs' behavior while they were swimming, the number of dogs that were either overexcited or were not able to swim by themselves was compared among 5 consecutive swimming times by Chi-square test. The odd ratios (OR) of the 2nd to 5th swimming time were calculated by compared with the 1st swimming time. Moreover, the number of dogs with abrasion wounds at the armpits was compared between groups that wore and did not wear swimsuits. The number was separately compared among 5 swimming times by Chi-square test. The odd ratios were also calculated. The statistic procedures were done by Epi Info™ Version 7.0.9.34.

Results

Some animals were able to swim by themselves, but some animals needed a trainer present – either with them in the water, or standing nearby at the edge of the pool (Fig 1). The 412 dogs in this study could be classified into four groups, based on the aim of swimming: for entertainment (n= 152), weight reduction (n= 53), rehabilitation after orthopedic surgery (n= 81), and rehabilitation for muscle and joint disease (n= 126).

From observation of the animals' behavior during swimming, it was found that at the 1st swimming time some dogs (29.13%) showed overexcitement and/or fear during swimming;

Figure 1 Dogs swimming under different conditions: with or without a trainer in the pool; and with or without wearing swimsuits.

Figure 2 Abrasion wound at armpit.

however when the dogs swam for the 2nd, 3rd, 4th and 5th times, this percentage significantly (p< 0.01) and steadily decreased: 26.77, 22.13, 12.82 and 6.80%, respectively (Table 2). Without swimsuits, 36.51% of the dogs could not swim by themselves at first; this number also significantly (p< 0.01) and steadily decreased: 26.97, 19.28, 13.46 and 12.41% for the 2nd, 3rd, 4th and 5th times, respectively (Table 2).

Abrasion wounds at the armpits of the forelimb (Fig 2) was found in 15.78, 17.32, 16.12, 18.52 and 18.34% of the dogs at the 1st, 2nd, 3rd, 4th and 5th swimming times, respectively (Table 3). However, when categorized as to whether or not the dogs wore swimsuits (Table 4), dogs with swimsuits had a much significantly (p< 0.01) higher percentage of abrasion wounds (23.77, 27.59, 24.00, 27.18 and 26.94%) than those without swimsuits (6.35, 5.62, 6.63, 7.69 and 6.90%).

Dry hair and dry skin were the most common side effects found among the animals in this study: in 20.63% and 18.93% of the dogs, respectively, after the 1st swimming time. This number significantly increased (p< 0.01) with increased frequency of swimming (Table 3). Red eyes were found in 13.59, 11.29, 9.84, 7.98 and 6.51% of the dogs at the 1st, 2nd, 3rd, 4th and 5th swimming times, respectively; this number also significantly increased (p< 0.01) with increased frequency of swimming. Otitis was found in 6.31, 5.25, 4.1, 4.56 and 3.85% of the dogs at the 1st, 2nd, 3rd, 4th and 5th swimming times, respectively. Finally, only 0.49, 0.26 and 0.28%, at the 1st, 2nd and 4th swimming times, respectively, had respiratory problems, with serous nasal discharge and sneezing; however, no dogs showed signs of pneumonia.

Table 2 Swimming behavior.

Behavior	Swimming time					p-value*
	1st	2nd	3rd	4th	5th	
Overly excited while swimming	120/412 (29.13%) OR=1.000	102/381 (26.77%) OR=0.890	81/366 (22.13%) OR=0.692	45/351 (12.82%) OR=0.358	23/338 (6.80%) OR=0.178	<0.001
Not able to swim by themselves	69/189 (36.51%) OR=1.000	48/178 (26.97%) OR=0.642	32/166 (19.28%) OR=0.415	21/156 (13.46%) OR=0.271	18/145 (12.41%) OR=0.246	<0.001

*compared between dogs with the side effects, while the odd ratios (OR) of the 2nd to 5th swimming times were calculated by comparing with the 1st swimming time.

Table 3 Side effects at different swimming times.

Side effect	Swimming time					*p*-value*
	1st (n = 412)	2nd (n = 381)	3rd (n = 366)	4th (n = 351)	5th (n = 338)	
Abrasion wound	65 (15.78%) OR=1.000	66 (17.32%) OR=1.119	59 (16.12%) OR=1.026	65 (18.52%) OR=1.213	62 (18.34%) OR=1.199	0.318
Dry hair	85 (20.63%) OR=1.00	98 (25.72%) OR=1.332	123 (33.61%) OR=1.947	206 (58.69%) OR=5.465	265 (78.40%) OR=27.553	<0.001
Dry skin	78 (18.93%) OR=1.000	67 (17.59%) OR=0.914	98 (29.78%) OR=1.566	169 (48.15%) OR=3.976	192 (56.80%) OR=5.631	<0.001
Red eye	56 (13.59%) OR=1.00	43 (11.29%) OR=0.809	36 (9.84%) OR=0.694	28 (7.98%) OR=0.551	22 (6.51%) OR=0.443	<0.001
Otitis	26 (6.31%) OR=1.000	20 (5.25%) OR=0.823	15 (4.1%) OR=0.634	16 (4.56%) OR=0.709	13 (3.85%) OR=0.594	0.096
Respiratory problem	2 (0.49%) OR=1.000	1 (0.26%) OR=0.539	0 (0%) OR=0.000	1 (0.28%) OR=0.586	0 (0%) OR=0.000	0.146

*compared between dogs with the same side effect, while the odd ratios (OR) of the 2nd to 5th swimming times were calculated by comparing with the 1st swimming time.

Table 4 Number of animals with abrasion wounds at armpits.

	Swimming time				
	1st	2nd	3rd	4th	5th
With swimsuit	53/233 (23.77%)	56/203 (27.59%)	48/200 (24.00%)	53/195 (27.18%)	52/193 (26.94%)
Without swimsuit	12/189 (6.35%)	10/178 (5.62%)	11/166 (6.63%)	12/156 (7.69%)	10/145 (6.90%)
Odd ratio*	4.343	6.400	4.450	4.479	4.479
p-value*	<0.001	<0.001	<0.001	<0.001	<0.001

* Comparative at the same swimming time between with and without swimming suit

Discussion

This study is the first report on the side effects in dogs from swimming in a chlorinated swimming pool. The results included dogs that swam from the 1st through the 5th times; the interval between each session was no longer than 5 days. The number of animals participating in the study gradually decreased from the 1st to the 5th swimming times (n= 412, 381, 366, 351, 338). This study ended after the 5th swimming time for several reasons, primarily because an increasing number of animals swimming at intervals of longer than 5 days.

Most owners of dogs participating in the study believed that their dogs would be able to swim without training, using natural behavior. However, the results showed that many dogs needed to be trained to swim. At the 1st swimming time, 36.51% of the dogs could not swim by themselves; however the other 63.49% were able to swim without a trainer. The number of dogs that could not swim alone decreased during the course of the study; by the 5th swimming time only 12.41% of the dogs were unable to swim unassisted.

Not all dogs were happy to swim; 29.13% were observed to be overly excited at the 1st swimming time. However, this number steadily decreased, to only 6.80% at the 5th swimming time. This indicates that animals need to become accustomed to swimming, and gain experience.

A high number of abrasion wounds were found, in dogs both with and without swimsuits. There was no significant difference in the percentage of dogs with abrasion wounds from the 1st to the 5th swimming times; but the occurrence was much higher in dogs wearing swimsuits (Table 4). In dogs with swimsuits, the border of the swimsuits scraped or rubbed the armpits; but in dogs without swimsuits, it was found that the skin surfaces on either side of the armpits rubbed against each other. This problem was observed more often among dogs that swam frequently, either with or without swimsuits, i.e. dogs swimming for purposes of rehabilitation – animals in this group swam continuously for at least 20 min at a time, 3 times per day, with 5-min rest periods in between. To decrease the number of abrasion wounds at the armpits, the following guidelines are recommended: 1) do not wear let the dog wear a swimsuit, especially one that is too small; 2) do not allow the dog to continue swimming for too long (more than 30 min without rest); and 3) train the dog so it feels comfortable and not excited during swimming; if the dog is overly excited, too much use and/or too strong movements of the legs can cause abrasion wounds at the armpits.

The most common side effect found in this study was dry hair (20.63% at the 1st swimming time), while the second most common was dry skin (18.93% at the 1st swimming time). Both side effects dramatically increased: to 78.40% and 58.60%, respectively, at the 5th swimming time. This is a direct effect of chlorine, which is used to control the water quality in a swimming pool. A previous study showed that chlorine can destroy the lipid layer coating the hair and skin, resulting in decreased moisture on the hair and skin surface, and leading ultimately to death of epithelial cells (Florentin et al., 2011).

Red eyes were found in 13.59% of the dogs at the 1st swimming time; this decreased to 6.51% at the 5th swimming time. Red eye is caused by water irritation; and all animals showing symptoms of red eye were among those categorized as "overly excited". However, recovery from this ailment can occur naturally in 1-2 days without any treatment. In addition to red eye, otitis was more prevalent in the overly excited group as well. The eyes and ears of an excited animal are more exposed to the chlorinated water, which can result in irritation. A previous study found that chlorinated water is more irritating to the eyes and ears than non-chlorinated water (Rylander et al., 1973).

A study by Voisin et al. (2010) showed that infant swimming is associated with a dose-dependent increase in the risk of bronchiolitis. Exposure to chlorinated pools during infancy also interacts with bronchiolitis to increase the risks of asthma and respiratory allergies later during childhood, which suggests that infant swimming practices may have a more long-standing impact on the respiratory health of children. Another study concluded that chlorinated pool exposure exerts an adjuvant effect on atopy that seems to contribute significantly to the burden of asthma and respiratory allergies among adolescents (Bernard et al., 2009). However, in our study only 0.49% of the animals showed signs of respiratory problems at the 1st swimming time, and 0.26% and 0.28% at the 2nd and 4th swimming times, respectively. Moreover, we did not observe dogs coughing water during swimming, even though the dog may have shown a high level of excitement. This could be the reason for the low number of animals with respiratory problems after swimming.

Another effect of chlorinated swimming pools on human health is tooth erosion. Previous studies found 31.4% tooth erosion from loss of enamel and dentine as a result of tooth contact with water with pH lower than 5.5 (Gabai et al., 1988; Geurtsen, 2000; Dawes and Boroditsky, 2008). This side effect was most frequently found in swimmers who are in contact with chlorinated water for long periods. However, in our study we did not observe this side effect. To determine whether this effect will be found in dogs, a long-term study should be performed. In the meantime, based on human studies, the pH of swimming pool water should not be lower than 5.5, and a pH level of 7.2–8.4 is recommended to prevent tooth erosion.

In conclusion, the main side effects in dogs from swimming in a chlorinated swimming pool are dry skin and hair, which are caused by chlorine in the water. The other major side effect is abrasion wounds at the armpits, which are found more frequently in dogs wearing swimsuits, or in dogs that continued to swim for a long period of time. The findings of this study can be used by veterinarians to inform pet owners about the potential adverse side effects which could occur from swimming in chlorinated swimming pools.

Acknowledgements

The authors gratefully acknowledge the veterinarians and technician assistants at the Metta Animal Hospital, Chiang Mai, for their kind support during the study. We wish to thank the National Research University Project under Thailand's Office of the Higher Education Commission and the Thailand Research Fund for financial support (MRG5380026). The authors also express their gratitude and thanks to all staff at the Bone and Joint Research Laboratory, Faculty of Veterinary Medicine, Chiang Mai University, for their generous assistance.

References

Silva, L.E., Valim, V., Pessanha, A.P., Oliveira, L.M., Myamoto, S., Jones, A. and Natour, J. 2008. Hydrotherapy versus conventional land-based exercise for the management of patients with osteoarthritis of the knee: a randomized clinical trial. Phys Ther. 88: 12-21.

Tanaka, H. 2009. Swimming exercise: Impact of aquatic exercise on cardiovascular health. Sports Med. 39: 377-387.

Voisin, C., Sardella, A., Marcucci, F. and Bernard, A. 2010. Infant swimming in chlorinated pools and the risks of bronchiolitis, asthma and allergy. Eur Respir J. 36: 41-47.

Wang, T.J., Belza, B., Elaine Thompson, F., Whitney, J.D. and Bennett, K. 2007. Effects of aquatic exercise on flexibility, strength and aerobic fitness in adults with osteoarthritis of the hip or knee. J Adv Nurs. 57: 141-152.

Weisgerber, M.C., Guill, M., Weisgerber, J.M. and Butler, H. 2003. Benefits of swimming in asthma: effect of a session of swimming lessons on symptoms and PFTs with review of the literature. J Asthma 40: 453-464.