Research article

Canine cutaneous tumors in Sriracha district, Chonburi province, Thailand: a retrospective analysis of relative frequency and risk factors

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Abstract

A retrospective epidemiological study was conducted to identify a relative frequency of canine cutaneous tumors between January 2018 - December 2019 across Sriracha district, Chonburi province, Thailand and demonstrated the associations between age, sex, neuter status, breed types, anatomical locations, and body weight with skin tumors diagnosis. A total of 94 canine biopsy specimens according to 87 dogs were submitted for histopathological classification. The highest relative frequencies in this study were mast cell tumors (19.1%), followed by melanoma (8.5%), lipoma (7.4%), and histiocytoma (6.4%). The most frequent locations of tumor were found at limbs (24.4%), head (23.5%), trunk and flank (18.3%), and perineum (13.9%). A single type of cutaneous tumor was more regularly found than multiple types. The risk of developing cutaneous tumors increased significantly in the large-breed dogs (greater than 20 kg) compared to medium- and small-breed dogs. Male dogs had 5.28 times of the odds having tumors compared to female dogs (P=0.002). Moreover, the occurrence of skin tumors is more common in elderly dogs. Our findings serve as a useful baseline information for regional veterinarians to establish a preliminary diagnosis of canine cutaneous tumors.

Keywords: Canine, Cutaneous tumor, Histopathology, Chonburi, Thailand

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INTRODUCTION

Cutaneous tumors are becoming important and more frequently seen in human and animal. The histological study is widely used for diagnosis and prognosis in treatment outcome (Pakhrin et al., 2007; Rungsipipat et al. 2003). The skin is a common organ exposed physical and chemical stimulants that the chronic exposure might develop the tumor proliferation (Chikweto et al., 2011; Pakhrin et al., 2007). Relatively 30% of all tumors were reported as skin tumors in dogs and the incidence rate of canine skin tumor was reported as 728 cases every year per 100,000 dogs (Pakhrin et al., 2007). Several studies reported the different relative frequency and incidence rate among populations (Chikweto et al., 2011). There were many studies revealed the retrospective study in canine cutaneous tumors around the world (Kok et al., 2019; Pakhrin et al., 2007; Rungsipipat et al. 2003). Interestingly, mast cell tumor, lipoma and soft tissue sarcoma were commonly reported in many studies (Kok et al., 2019; Chikweto et al., 2011; Pakhrin et al., 2007; Rungsipipat et al. 2003). The data presented in many studies indicated age, sex and breed predilection in tumor progression.

The epidemiological data informed by the national canine cancer registries and veterinary authorities or reported from university laboratory services which were different among population (Kok et al., 2019). There were many studies focused on canine cutaneous tumors in many countries across the world (Kok et al., 2019; Machado et al., 2018; Šoštarić-Zuckermann et al., 2013; Chikweto et al., 2011; Pakhrin et al., 2007; Rungsipipat et al. 2003). However, there was no study revealed the canine cutaneous tumors in Chonburi, Thailand. Thus, this research aimed to identify the histological types of canine cutaneous tumors, analyze the relative frequency of each tumor and estimate the risk factor among dog population from three distinct animal hospitals of Sriracha, Chonburi. The data would provide the baseline information for veterinarians in tumor diagnosis, treatment planning and prognosis.

MATERIALS and METHODS

Study population

From January 2018 to December 2019, 94 canine biopsy specimens from 87 dogs collected from three animal hospitals in Chonburi province, Thailand were diagnosed as canine skin tumors and included in this study. Additionally, a total number of canine tumor cases acquired from these animal hospitals were 123 samples according to 115 dogs; however, other kinds of tumors were not mentioned in this study. These samples were submitted for histopathological examination and finally confirmed by the Pathology Unit, Faculty of Veterinary Medicine, Rajamangala University of Technology Tawan-ok, Chonburi. Clinical details including breed, age, sex, neuter status, body weight, and tumor location were also recorded. Body weight was classified into 4 groups as small breed (<10 kg), medium breed (10-20 kg), large breed (20-40 kg) and giant breed (>40 kg).

Histological classification of study subjects

In our study, all tumor samples were categorized into 5 groups according to the recent WHO classification as epithelial tumors, melanocytic tumors, mesenchymal tumors, hemolymphatic tumors, and tumor-like lesion located on the skin (Kok et al., 2019).

Statistical analysis

Descriptive statistics were computed for the most variables. To assess the influence of sex, age, breed and body weight on the development of skin tumor, the analysis with likelihood ratio test and Pearson's chi-square test, using R version 3.1.2 (R foundation for statistical computing, Vienna, Austria) were applied. Risk factors were defined as sex (male, female), neuter status (intact and neutered), breed (pure breeds and mixed breed), and age (classified in two groups: dog aged ≤5.0 years and >5.0 years), and body weight (classified in 4 groups: <10.0, 10.0-20.0, 20.0-40.0, and >40.0 kg). Results were reported as odds ratios (OR) with its associated 95% confidence interval (CI), and a P-value of less than 0.05 was considered to be significant.

RESULTS

Nighty-four specimens from 87 dogs across Chonburi province during 2018-2019 were diagnosed as canine skin tumors. Twenty-five different types of skin tumors were classified into epithelial tumors 36.2% (34/94), melanocytic tumors 8.5% (8/94), mesenchymal tumors 19.1% (18/94), hemolymphatic tumors 39.4% (37/94) and tumor-like lesion 1.1% (1/94) (Table 1). Of these, mast cell tumors showed the highest frequency 19.1% (18/94), followed by melanoma 8.5% (8/94), lipoma 7.4% (7/94) and histiocytoma 6.4% (6/94) (Table 1). One more interesting point, extra-genital transmissible venereal tumor (ETVT) cases were also recorded 4.2% (4/94).

Table 1 Number of biopsy samples and relative frequency (%) of canine skin tumors (n=94) based on histological diagnosis from animal hospitals in Chonburi province, Thailand 2018-2019

Types of tumor	Number of samples	Relative frequency (% of all skin tumors)
Epithelial tumors	34	36.2
Epidermal tumors	7	7.4
Papilloma	2	2.1
Squamous cell carcinoma	5	5.4
Hair follicle tumors	9	9.6
Trichoblastoma	5	5.4
Trichoepithelioma	3	3.2
Pilomatricoma	1	1.1
Sebaceous and modified sebaceous gland tumors	8	8.5
Sebaceous epithelioma	2	2.1
Sebaceous carcinoma	1	1.1
Meibomian epithelioma	4	4.2
Hepatoid gland adenoma	1	1.1
Apocrine gland tumors	6	6.4
Apocrine adenoma	5	5.4
Apocrine carcinoma	1	1.1
Epithelial tumors	4	4.2
Adenoma	3	3.2
Adenocarcinoma	1	1.1
Melanocytic tumors	8	8.5
Melanoma	8	8.5
Mesenchymal tumors	18	19.1
Soft tissue tumors	10	10.6
Fibroma	2	2.1
Lipoma	7	7.4
Fibrosarcoma	1	1.1
Vascular tumors	8	8.5
Hemangioma	3	3.2
Hemangiosarcoma	3	3.2
Perivascular wall tumor	2	2.1
Hemolymphatic tumors	37	39.4
Mast cell tumor	18	19.1
Lymphoma	5	5.4
Histiocytoma	6	6.4
Extragenital transmissible venereal tumor	4	4.2
Tumor-liked lesion	1	1.1
Sebaceous gland hyperplasia	1	1.1
Total	**94**	**100**

Of the cases based on the number of patient dogs (Table 2), 54% were female (47/87), 60.9% were intact (53/87), and 64.4% were pure-breed (56/87). Seventy-two of 87 cases (86.2%) were over than 5 years old and the median age at diagnosis was 9 years (range from 1 to 16 years). The most common frequency (49.4%) of the cases was large breed dogs (20-40 kg) and median body weight was 19.2 kg ranging from 3.4-62.0 kg. The prevalence of the single tumor was 94.3%, while the multiple tumors was 5.7% (Table 2). The site distributions of these 25 cutaneous tumors were commonly occurred on the limbs (24.38%), head (23.47%), trunk and flank (18.26%), and perineal area (13.91%), respectively (Figure 1).

Table 2 Number of cases (patient dogs) and relative frequency (%) of canine skin tumors (n=87) based on particular factors

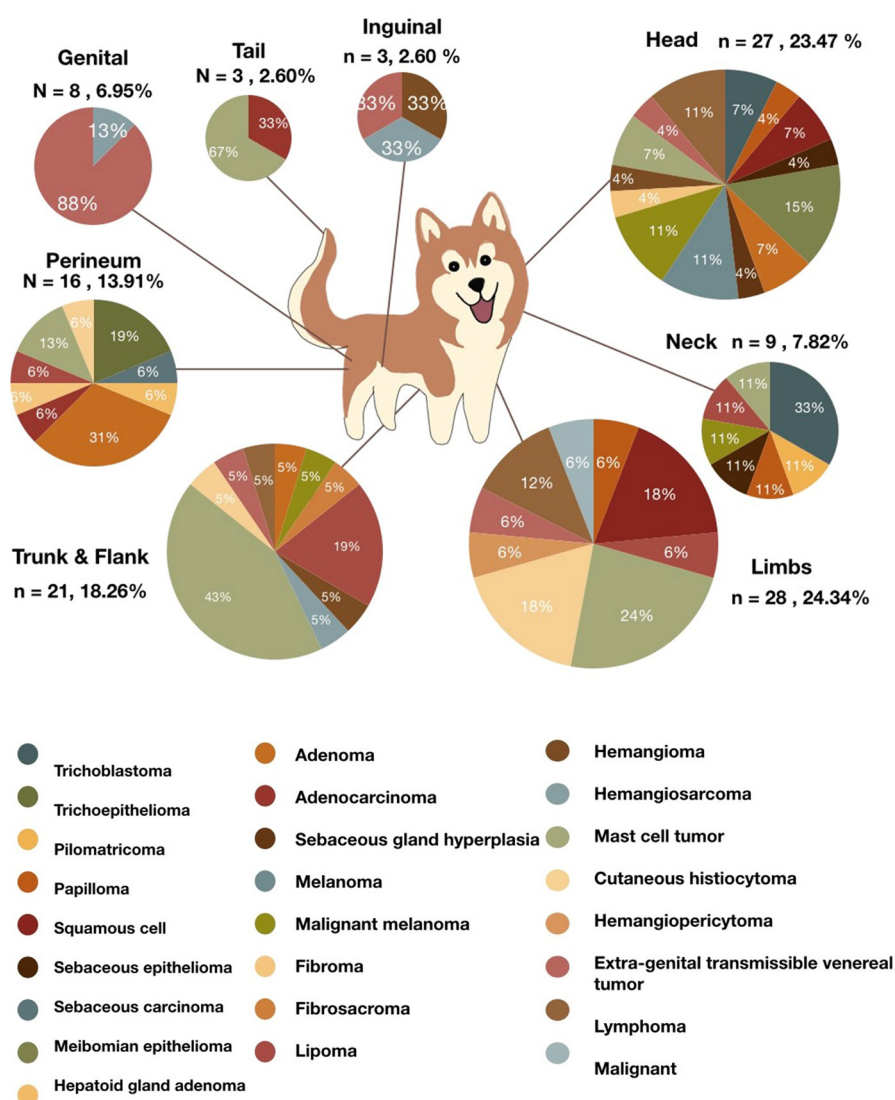| Factors	Categories	Number of cases	Relative frequency (% of all skin tumors)
Age	≤ 5.0 years	12	13.8
	>5.0 years	75	86.2
Sex	Male	40	46.0
	Female	47	54.0
Neuter status	Intact	53	60.9
	Neutered	34	39.1
Breed type	Pure-breed	56	64.4
	Mixed-breed	31	35.6
Body weight	<10.0 kg	23	26.4
	10.0-20.0 kg	15	17.2
	20.0-40.0 kg	43	49.4
	>40.0 kg	6	6.9
Tumor lesions	Single tumor	82	94.3
	Multiple tumor	5	5.7

Figure 1 The most common anatomical locations of canine cutaneous tumors (n=number of tumors) and the relative frequency (%) of the most frequently encountered tumor types in each site.

Based on the number of specimens (n=94) in this study, sex and body weight were significantly associated with the prevalence of canine skin tumor (Table 3). The male dogs had the higher relative frequency (88.9%) than the female dogs (60.3%) with OR = 5.28, 95% CI = 1.876 - 14.846, P= 0.002. The odds of diagnosed as canine skin tumor could be determined by the body weight of the dogs. The large breed dogs (20.0-40.0 kg) had 84.3% of relative frequency with OR = 3.42, 95% CI = 1.403 - 8.338, P= 0.010, while the small breed dogs (<10.0 kg) had lowest relative frequency of 57.5% with OR = 0.40, 95% CI = 0.179 - 0.902, P= 0.043 (Table 3). The relative frequency of the medium breed (10.0-20.0 kg) and giant breed (>40.0 kg) were 68.2% and 60%, respectively. Dogs over 5 years old had 1.25 times the odds of canine skin tumor diagnosis compared with the dogs under or equal 5 years old. Neutered status has affected the occurrence of cutaneous tumor (80.9%) along with the odds of 2.24, while intact dogs had 65.4% of relative frequency. In addition, mixed-breed dogs were at 1.25 times the odds and pure-breed dogs were at 0.79 times the odds of having skin tumor.

Table 3 Univariate analysis of risk factors associated with canine skin tumors from animal hospitals in Chonburi province, Thailand 2018-2019

Factors	Categories	Tumor cases[a]	Skin tumor cases[b]	RF[c] (%)	OR	95% CI (OR)	P-value[d]
Age	<5.0 years	18	12	66.7	0.80	0.275 - 2.327	0.897
	>5.0 years	105	75	71.4	1.25	0.430 - 3.635	0.897
Sex	Male	45	40	88.9	5.28	1.876 - 14.846	0.002*
	Female	78	47	60.3	0.19	0.067 - 0.533	0.002*
Neuter status	Intact	81	53	65.4	0.45	0.182 - 1.091	0.113
	Neutered	42	34	80.9	2.24	0.917 - 5.501	0.113
Breed type	Pure-breed	81	56	69.1	0.79	0.345 - 1.830	0.740
	Mixed-breed	42	31	73.8	1.25	0.547 - 2.897	0.740
Body weight	<10.0 kg	40	23	57.5	0.40	0.179 - 0.902	0.043*
	10.0-20.0 kg	22	15	68.2	0.86	0.319 - 2.335	0.975
	20.0-40.0 kg	51	43	84.3	3.42	1.403 - 8.338	0.010*
	>40.0 kg	10	6	60.0	0.59	0.157 - 2.240	0.678

[a]A total number of canine tumor cases (n=123) visited at three animal hospitals in Chonburi, 2018-2019.
[b]A total number of canine skin tumor cases (n=94) visited at three animal hospitals in Chonburi, 2018-2019.
[c]Relative frequency (RF) is canine skin tumors cases given all total cases of tumor.
[d]Chi-square test.
*significance level of $P < 0.05$.

DISCUSSION

This retrospective epidemiological study identified a prevalence of canine cutaneous tumors over the study period of 2018-2019 in Sriracha district, Chonburi province, Thailand and demonstrated the associations between age, sex, neuter status, breed types and body weight with cutaneous tumors diagnosis. According to the current study, the most common relative frequency of canine cutaneous tumors was mast cell tumors, melanoma, lipoma, and histiocytoma. These results were in accordant to previous studies in different geographic regions including the U.S.A. (Villamil et al., 2011; Brody, 1970), Brazil (Moraes et al., 2009), the U.K. (Shoop et al., 2015; Bostock,1986), Denmark (Brønden

et al., 2010), Switzerland (Graf et al., 2018), Croatia (Artuković et al., 2014), Greece (Kaldrymidou et al., 2002), Japan (Kok et al., 2019), Korea (Pakhrin et al., 2007), Australia (Shaw et al., 2018; Finnie and Bostock, 1979), and Grenada island (Chikweto et al., 2011). Among these studies, mast cell tumors have been highlighted for the most outstanding cutaneous tumors in companions potentially aiding veterinarian awareness and facilitating diagnosis.

Anatomical locations of cutaneous tumors in dogs were commonly distributed over the whole bodies including head and neck, limbs, extremities, trunk and perineum (Kok et al., 2019; Graf et al., 2018; Artuković et al., 2014; Pakhrin et al, 2007) which was coincident with our findings. Thus, it can be implied that any parts on skin which could be exposed to chemical and/or physical insults are prone to neoplastic proliferation (Pakhrin et al, 2007; Kaldrymidou et al., 2002). Moreover, only one type of cutaneous tumor was more commonly found on dogs than multiple types of tumor in this study. However, the latter type of tumor could be found also which reminded the clinicians to aware of the importance of opened-range diagnosis and sending more than one of the tumors for analysis (Artuković et al., 2014).

The potential risk factors of canine skin tumors including age, sex, neuter status, breed types and body weight were analyzed in the recent study. Among these risk factors of canine skin tumor, there has been a significant association between sex and the occurrence of cutaneous tumors (P-value = 0.002). In addition, male dogs had 5.28 times of the odds having tumors compared to female dogs, while some studies reported there was no significant difference between sex (Pakhrin et al, 2007; Shoop et al, 2015). However, particular types of cutaneous tumors related with sex hormone such as hepatoid gland tumors and apocrine adenocarcinoma tended to show the sex predilection in dog population (Pakhrin et al, 2007). Several earlier studies described that larger-sized breeds were at higher risk of developing cutaneous tumors than medium and smaller breeds (Shoop et al, 2015; White et al., 2011). Similarly, our study found that dogs over 20 kg had over triple times the odds of having cutaneous tumors compared to smaller-sized dogs with 95% CI of odds ratio = 1.403 - 8.338. From this finding maybe implied that the larger dogs (body weight > 20 kg) might be obese dogs which were prone to tumor-occurring than good body-condition dogs that was similar to the study in human or rodent (Romano et al., 2016).

This study also supported the findings from Shoop et al. (2015) of no difference in mast cell tumors occurrence between pure-breed types and mixed-breed types. Unlike those findings, the study from the Swiss Canine Cancer Registry stated that the overall incidence rate of skin tumors in mixed-breed dogs had a more than 2.5-fold higher than the average rate of all breeds (Graf et al, 2018). However, a number of researches calculated the odds of cutaneous tumor development in pure-breed by using the mixed-breed dogs as reference and revealed that some specific large breed types including Boxers, Golden retriever, as well as Labrador retriever were a predisposing cause for skin tumors (Shoop et al., 2015; Artuković et al., 2014; Villamil et al., 2011; Chikweto et al., 2011). Even though, the mixed-breed dogs are popular and available in Thailand, the owners of purebred dogs are more affordable and accessible for tumor diagnostic and treatment than another. Therefore, the economical status of dog owners also has the impact on the types and number of samples counted in the study. In the current study, neuter dogs had 2.24 times the odds of having cutaneous tumors compared to intact dogs even it was just a trending. This result was in agreement

with a couple reports which mentioned that spayed females and castrated males had possibly increased the risk for developing cutaneous tumors compared to intact dogs (Shoop et al., 2015; White et al., 2011). Although the reasons for this are unknown, sexual hormone receptors found in cutaneous tumors need more attention and investigation (White et al., 2011). However, limitations of the current study might also contribute to the sample size, document of spaying or castrating, as well as age at the time of neutering. The median age of affected dogs in our study was 9 years which were consisted with the common range for the occurrence of most neoplasms in dogs, that is, greater than 8 to 15 years of age (Graf et al, 2018; Villamil et al., 2011; Pakhrin et al 2007). Generally, the occurrence of skin tumors is more common in elderly dogs (Graf et al, 2018; Artuković et al., 2014; Villamil et al., 2011), supported by our results indicated a peak in the odds of developing skin tumors increased in more than 5 years old dogs. Especially, we found the incidence of ETVT on skin in our dog-population which is different from the previous studies in the area of developed countries (Graf et al, 2018; Villamil et al., 2011). The spreading of ETVT indicated the dog-population control in the area is lacked but the owners still concern to treat the dogs with care.

CONCLUSION

The retrospective epidemiological study in canine cutaneous tumors revealed mast cell tumors as the most commonly seen in veterinary practice in this regional area. The risk factor analysis indicated that aged, large-breed or male dog are tended to occur the cutaneous tumor increasingly. Male dogs were prone to occur cutaneous tumor than female dogs significantly. The specific tumor such as ETVT is commonly seen in area depending on specific epidemiological finding. All this information may help the practitioners facing the cutaneous cases and justifying how to manage the cases systemically.

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AUTHOR CONTRIBUTIONS

Collected and categorized data: PS. Conceived and designed analysis: SP. Analyzed the data: PS, SP. Artwork and table designed: PS, SP. Wrote the manuscript: PS, SP.

REFERENCES

Artuković, B., Medven, L., Hohšteter, M., Šoštarić-Zuckermann, I.C., Gudan Kurilj, A., Beck, A., Huber, D., Grabarević, D., Severin, K., Grabarević, Ž. 2014. Prevalence of cutaneous mast cell sarcoma in dogs in Croatia. Vet. arhiv. 84(6), 601-614.

Bostock, D.E. 1986. Neoplasms of the skin and subcutaneous tissues in dogs and cats. Br. Vet. J. 142(1), 1-19.

Brodey, R.S. 1970. Canine and feline neoplasia. Adv. Vet. Sci. Comp. Med. 14, 309-354.

Brønden, L.B., Eriksen, T., Kristensen, A.T. 2010. Mast cell tumours and other skin neoplasia in Danish dogs-data from the Danish Veterinary Cancer Registry. Acta Vet. Scand. 52(1), 6.

Chikweto, A., McNeil, P., Bhaiyat, M.I., Stone, D., Sharma, R.N. 2011. Neoplastic and nonneoplastic cutaneous tumors of dogs in Grenada, West Indies. Int. Sch. Res. Netw. ISRN Vet. Sci. 2011:416435.

Finnie, J.W., Bostock, D.E. 1979. Skin neoplasia in dogs. Aust. Vet. J. 55(12), 602-604.

Graf, R., Pospischil, A., Guscetti, F., Meier, D., Welle, M., Dettwiler, M. 2018. Cutaneous tumors in Swiss dogs: Retrospective data from the Swiss canine cancer registry, 2008–2013. Vet. Pathol. 55(6), 809-820.

Kaldrymidou, H., Leontides, L., Koutinas, A.F., Saridomichelakis, M.N., Karayannopoulou, M. 2002. Prevalence, distribution and factors associated with the presence and the potential for malignancy of cutaneous neoplasms in 174 dogs admitted to a clinic in northern Greece. J. Vet. Med. A. 49(2), 87-91.

Kok, M.K., Chambers, J.K., Tsuboi, M., Nishimura, R., Tsujimoto, H., Uchida, K., Nakayama, H. 2019. Retrospective study of canine cutaneous tumors in Japan, 2008–2017. J. Vet. Med. Sci. 19-0248.

Machado, G.A., Fontes, T.N., Larangeira, D.F., Estrela-Lima, A., Moreira, E.L., Ribeiro, L.S., Pinto, M.P., Peixoto, T.C. 2018. Incidence of skin tumors in dogs in Salvador, Bahia state, Brazil (2007-2016). Pesquisa Vet. Brasil. 38(11), 2139-2145.

Moraes, J.R.E., Beretta, D.C., Zanetti, A.S., Garrido, E., Miyazato, L.G., Sevarolli, A.L. 2009. Cutaneous tumors in dogs-A retrospective study of ten years. Vet. Notícias. 15(1), 59–68.

Pakhrin, B., Kang, M.S., Bae, I.H., Park, M.S., Jee, H., You, M.H., Kim, J.H., Yoon, B.I., Choi, Y.K., Kim, D.Y. 2007. Retrospective study of canine cutaneous tumors in Korea. J. Vet. Sci. 8(3), 229-236.

Romano, F.R., Heinze, C.R., Barber, L.G., Mason, J.B., Freeman, L.M. 2016. Association between body condition score and cancer prognosis in dogs with lymphoma and osteosarcoma. J. Vet. Intern. Med. 30(4), 1179-1186.

Rungsipipat, A., Sunyasootcharee, B., Ousawaphlangchai, L., Sailasuta, A., Thanawongnuwech, R., Teankum, K. 2003. Neoplasms of dogs in Bangkok. Thai J. Vet. Med. 33(1), 59–66.

Shaw, T., Kudnig, S.T., Firestone, S.M. 2018. Diagnostic accuracy of pre-treatment biopsy for grading cutaneous mast cell tumours in dogs. Vet. Comp. Oncol. 16(2), 214-219.

Shoop, S.J., Marlow, S., Church, D.B., English, K., McGreevy, P.D., Stell, A.J., Thomson, P.C., O'Neill, D.G., Brodbelt, D.C. 2015. Prevalence and risk factors for mast cell tumours in dogs in England. Canine Genet. Epidemiol. 2(1), 1.

Šoštarić-Zuckermann, I.C., Severin, K., Hohšteter, M., Artuković, B., Beck, A., Kurilj, A.G., Sabočanec, R., Džaja, P., Grabarević, Ž. 2013. Incidence and types of canine tumours in Croatia. Vet. Arhiv. 83, 31-45.

Villamil, J.A., Henry, C.J., Bryan, J.N., Ellersieck, M., Schultz, L., Tyler, J.W., Hahn, A.W. 2011. Identification of the most common cutaneous neoplasms in dogs and evaluation of breed and age distributions for selected neoplasms. J. Am. Vet. Med. A. 239(7), 960-965.

White, C.R., Hohenhaus, A.E., Kelsey, J., Procter-Gray, E. 2011. Cutaneous MCTs: associations with spay/neuter status, breed, body size, and phylogenetic cluster. J. Am. Anim. Hosp. Assoc. 47(3), 210-216.