VETERINARSKI ARHIV 84 (6), 601-614, 2014

Prevalence of cutaneous mast cell sarcoma in dogs in Croatia

Branka Artuković[1]*, Lidija Medven[1], Marko Hohšteter[1], Ivan-Conrado Šoštarić-Zuckermann[1], Andrea Gudan Kurilj[1], Ana Beck[1], Doroteja Huber[1], Dunja Grabarević[3], Krešimir Severin[2], and Željko Grabarević[1]

[1]*Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Zagreb, Zagreb, Croatia*

[2]*Department of Forensic Veterinary Medicine, Faculty of Veterinary Medicine, University of Zagreb, Zagreb, Croatia*

[3]*Croatian Veterinary Institute, Zagreb, Croatia*

ARTUKOVIĆ, B., L. MEDVEN, M. HOHŠTETER, I.-C. ŠOŠTARIĆ-ZUCKERMANN, A. GUDAN KURILJ, A. BECK, D. HUBER, D. GRABAREVIĆ, K. SEVERIN, Ž. GRABAREVIĆ: Prevalence of cutaneous mast cell sarcoma in dogs in Croatia. Vet. arhiv 84, 601-614, 2014.

ABSTRACT

The prevalence of cutaneous mast cell sarcomas (MCSs) was investigated at the Department of Veterinary Pathology of the Faculty of Veterinary Medicine from January 1st, 2008 to December 31st, 2012. The frequency of tumor grades was established in relation to the breed, sex and localization in Croatia. In the analyzed period a total of 1939 tumors were diagnosed, of which 928 were skin tumors, and MCS were found in 125 animals, or in 13.47% of skin tumors. MCSs were found more frequently in male dogs (n = 77 or 61.6%) and the average age was 7.83 years. A higher incidence of these tumors were on the thorax (16.8%), hind limbs (12.8%), abdomen (12%), head (9.6%), forelimb (7.20%) and neck (6.4%). Golden Retrievers, mongrels and Boxers were the most frequent breeds. Grade I tumors were found in 24.8% (n = 31) of animals, of which 67.74% (n = 21) were male and 32.26 (n = 10) female; grade II was found in 41.6% (n = 52) of which 59.62% (n = 31) were male and 40.38% (n = 21) female; and grade III was found in 33.6% (n = 42) of which 59.53% (n = 25) were male and 40.44 (n = 17) female. The percentage of grades I, II and III in male dogs was 27.27%, 40.26% and 32.47% respectively and in females 20.83%; 43.75% and 35.42% respectively. The average age of dogs with grade I, II and III tumors was 7.82, 7.69, and 7.99 years respectively. The most frequent on the head was grade II, on the neck grades I and III equally, and on the forelimbs, hind limbs, back, abdomen, tail and preputium grade II was most frequent. The most frequent grade on the perineum, scrotum and multiple locations was grade III. In the Golden Retrievers the most frequent location of tumors was the thorax, in the mongrels there were multiple locations and in Boxers the abdomen was most frequent.

Key words: mast cell sarcoma, skin, prevalence, dog, Croatia

*Corresponding author:

Prof. dr. sc. Branka Artuković, D.V.M. Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Zagreb, Heinzelova 55, 10000 Zagreb, Croatia; Phone: +385 1 2390 186, E-mail: branka.artukovic@vef.hr

ISSN 0372-5480
Printed in Croatia

Introduction

Cancer has a very important role as a cause of death in dogs, especially older ones. In total 23% of all dogs die from tumors (WITHROW, 1996). One of these is a mast cell sarcoma (MCS), commonly encountered in small animal practice. The data about the incidence of MCSs differ. MCS accounts for 7-27% of skin neoplasms in dogs (BRODEY, 1970; PRIESTER, 1973; FINNIE and BOSTOCK, 1979; ROTHWELL et al., 1987; GOLDSCHMIDT and SHOFER, 1998; FOX, 1998; MISDORP, 2004; BLACKWOOD et al., 2012). Mast cell tumors are neoplastic proliferations of mast cells and should always be considered in the list of differential diagnoses for a skin mass (BLACKWOOD et al., 2012). The majority of canine MCT (mast cell tumors) occurs in the skin and subcutis, and they arise from tissue mast cells in the dermis and subcutaneous tissues. Tumors are usually solitary but may be multicentric. Multiple tumors occur in about 10% to 15% of cases (LONDON and SEGUIN, 2003). Clinically, mast cell tumors are generally alopecic, erythematous, edematous nodules that vary in size from several millimeters to several centimeters, and ulcerations are often present in larger tumors (GROSS et al., 2010).

MCSs most commonly occur in middle-aged and older dogs, with a mean age from 6.96 to 9 years, but they were also recorded in dogs under 1 year (GRABAREVIĆ et al., 2009; GROSS et al., 2010; BLACKWOOD et al., 2012; ŠOŠTARIĆ-ZUCKERMANN, 2013). There is no sex predisposition (GOLDSCHMIDT and SHOFER, 1998; BLACKWOOD et. al., 2012) but there is breed predilection in Boxers, Retrievers, Pugs, Boston terriers and Pit-bull terriers. In Boxers and Pugs MCSs are grade I or II with more favorable prognosis in Shar Peis.1 Younger animals (MILLER, 1995) are also predisposed to developing MCSs but these are often poorly differentiated and more aggressive (O'KEEFE, 1990; LONDON and SEGUIN, 2003; McNEIL et al., 2006; MULLINS et al., 2006; GRABAREVIĆ et al., 2009; GROSS et al., 2010). RABANAL and FERRER (2002) reported that 50% of MCSs in dogs appear on the trunk, 40% on the extremities, and 10% on the head. MCSs in the perineal region, scrotum, prepuce and digits are more aggressive (SCOTT et al., 2001) but GIEGER et al. (2003) described an increased regional metastatic rate of facial MCSs when compared with MCSs in other locations. It has been reported that certain predilection locations are associated with a particular breed. For example, Boxers, Boston Terriers, Pugs, English Setters and American Staffordshire Terriers tend to have tumors on the hind legs, Rhodesian Ridgebacks on the tail and English Setters often have tumors on the head (GOLDSCHMIDT and SHOFER, 1998).

Many MCS originate in the dermis and extend into the subcutis, but there is a subset that is restricted to the subcutaneous fat. This type has been described by NEWMAN et al. (2007) and THOMPSON et al. (2011). Results of a study conducted by THOMPSON et al. (2011) indicate that the majority of dogs with subcutaneous MCSs had prolonged survival rates, and decreased rates of local reoccurrence and metastasis than those reported for

grade II cutaneous MCSs. Subcutaneous tumors are more effectively controlled by surgery alone than their cutaneous counterparts. The most commonly used grading system was developed by PATNAIK et al. (1984) in which there are three different tumor grades, classified from I to III, with grade III as the most aggressive type. The histopathological grading is subjective, which results in variations between pathologists. The concordance among pathologists was 74% for the diagnosis of grade III MCT and less than 64% for diagnosis of grade I and II (NORTHRUP et al., 2005a and 2005b; KIUPEL et al., 2011). The major difference between grade I and grade II MCSs in this system is the extension of neoplastic cells into the subcutis (PATNAIK et al., 1984). To improve concordance between pathologists, a two-tier histological grading system has been proposed, which uses more specific and precise histological grading criteria, and eliminates the ambiguity of the intermediate grade. This grading includes high grade and low grade MCSs (KIUPEL et al., 2011). The diagnosis of high-grade MCSs is based on the presence of any one of the following criteria: at least 7 mitotic figures in 10 high-power fields (HPF); at least 3 multinucleated (3 or more nuclei) cells in 10 HPF; at least 3 bizarre nuclei in 10 HPF; karyomegaly (i. e. nuclear diameters of at least 10% neoplastic cells vary by at least two-fold). All other tumors are considered low grade (BLACKWOOD et al., 2012).

The aim of this study was to compile and present data on canine MCSs diagnosed in Croatia in the 2008-2012 period, and to compare these data with the literature. Another goal was to suggest the potential application of a two-tier histological grading system as a tool for veterinary pathologists to assess the potential biological behavior of MCSs in dogs. It seems this grading system provides more prognostic information than Patnaik's 3-tier grading system.

Materials and methods

A retrospective study was performed at the Department of Veterinary Pathology, Faculty of Veterinary Medicine, University of Zagreb, in the period from January 1st, 2008 to December 31st 2012, using all tumors in dogs presented for histopathological analysis, and all subcutaneous MCSs. Diagnoses were established by experienced veterinary pathologists using histopathologic evaluation of standard H&E stained microscopic slides. If the diagnosis was suspected, differential staining (Toluidine blue stain) was used to establish metacromasia of the mastocyte granules. The Patnaik system was used for histopathological grading of cutaneous MCSs. The incidence and distribution of this tumor in dogs, in relation to the sex, age, breed, grade and localization in Croatia were investigated. Statistical analysis of collected data was performed in Microsoft Office Excel.

Results

During the investigated period a total of 1939 different tumors in dogs (n = 983 or 50.70% in male dogs; n = 956 or 49.30% in female dogs) were diagnosed, of which 928 (n = 548 or 59.05% in male dogs; n = 380 or 40.95% in female dogs) cases were skin tumors. Of those, in 125 (n = 77 or 61.6% in male dogs; n = 48 or 38.4% in female dogs) animals mast cell tumors were found (Table 1). The dogs in this study ranged from 2 to 14 years of age. The mean age of the affected animals was 7.83 years (Table 2). Age was not recorded in fourteen cases.

Table 1. Frequency of mast cell sarcoma in relation to the total number of tumors and total number of skin tumors

Year	Total number of all tumors (n+%) (F+M)	Skin tumors (n+%) (F+M)	MCT (n+%) (F+M)
2008	397 (20.47%) (181F+216M) (45.59%F+54.41%M)	214 (23.96%) (148F+66M) (69.16%F+30.84%M)	16 (7.48%) (5F+11M) 31.25%F+68.75%M)
2009	395 /20.37%) (214F+181M) (54.18%F+45.82%M)	156 (16.35%) (60F+96M) 38.46%F+61.54%M)	21 (13.46%) (13F+8M) (61.9%F+38.1%M)
2010	377 (19.44%) (198F+179M) (52.52%F+47.48%M)	176 (18.43%) (55F+121M) (31.25%F+68.75%M)	27 (15.34%) (12F+15M) (44.4%F+55.6%M)
2011	360 (18.57%) (178F+182M) (49.44%F+50.56%M)	184 (17.34) (63F+121M) (34.24%F+65.76%M)	24 (13.04%) (9F+15M) (37.5%F+62.5%M)
2012	410 (21.14%) (185F+225M) (45.12%F+54.88%M)	198 (16.56%) (54F+144M) 27.27%F+72.73%M)	37 (18.67%) 9F+28M (24.32%F+75.68%M)
Total	1939 (956F+983M) 49.30%F+50.70%M	928 (47.86%) (380F+548M) (40.95%F+59.05%M)	125 (13.47%) (48F+77M) (38.4%F+61.6%M)

Table 2. Frequency of mast cell sarcoma in relation to sex and age

Year	Total	Male	Female	Age
2008	16	11 (68.75%)	5 (31.25%)	7.72
2009	21	8 (38.10%)	13 (61.90%)	7.12
2010	27	15 (55.56%)	12 (4.44%)	7.77
2011	24	15 (62.5%)	9 (37.5%)	8.75
2012	37	28 (75.68%)	9 (24.32%)	7.80
Total	125	77 (61.6%)	48 (38.4%)	7.83

Table 3. Frequency of mas cell tumor grades in relation to the breed and sex of the dogs

Breed	Total	Grade I.	Grade II.	Grade III.						
	125	Male	Female	Total	Male	Female	Total	Male	Female	Total
Golden Retriever	26 (20.8%)	2	2	4 (15.38%)	5	9	14 (53.85)	6	2	8 (30.77%)
Mongrel	19 (15.2%)	4	2	6 (31.58%)	4	2	6 (31.58)	5	2	7 (36.84%)
Boxer	14 (11.2%)	4	2	6 (42.86%)	2	3	5 (35.71)	1	2	3 (21.43%)
Labrador Retriever	12 (9.6%)	1	2	3 (25%)	2	2	4 (33.33)	1	4	5 (41.67%)
Pug	7 (5.6%)	2	0	2 (28.7%)	4	0	4 (57.14)	1	0	1 (14.29%)
Staffordshire Terrier	7 (5.6%)	0	0	0 (0%)	4	1	5 (71.43)	1	1	2 (28.57%)
Not known	4 (3.2%)	0	0	0 (0%)	2	0	2 (50%)	2	0	2 (50%)
Bullmastiff	4 (3.2%)	1	0	1 (25%)	2	0	2 (50%)	1	0	1 (25%)
Shar Pei	2 (1.6%)	2	0	2 (100%)	0	0	0 (0%)	0	0	0 (0%)
English Setter	2 (1.6%)	1	1	2 (100%)	0	0	0 (0%)	0	0	0 (0%)
Rottweiller	2 (1.6%)	0	0	0 (0%)	0	1	1 (50%)	0	1	1 (50%)
Maltese	2 (1.6%)	0	0	0 (0%)	2	0	2 (100%)	0	0	0 (0%)
Fox Terrier	2 (1.6%)	0	0	0 (0%)	2	0	2 (100%)	0	0	0 (0%)
Boston Terrier	2 (1.6%)	1	0	1 (50%)	0	0	0 (0%)	1	0	1 (50%)
Bernese Mountain Dog	2 (1.6%)	0	0	0 (0%)	0	0	0 (0%)	2	0	2 (100%)
Lassa Apsso	2 (1.6%)	2	0	2 (100%)	0	0	0 (0%)	0	0	0 (0%)
German Shepherd Dog	2 (1.6%)	1	0	1 (50%)	0	0	0 (0%)	1	0	1 (50%)
Dalmatian	1 (0.8%)	0	0	0 (%)	1	0	1 (100%)	0	0	0 (0%)
Rhodesian Ridgeback	1 (0.8%)	0	1	1 (100%)	0	0	0 (0%)	0	0	0 (0%)
Doberman	1 (0.8%)	0	0	0 (0%)	0	1	1 (100%)	0	0	0 (0%)
English Basset	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	0	1	1 (50%)
Pinscher	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	1	0	1 (50%)
Beagle	1 (0.8%)	0	0	0 (0%)	0	1	1 (100%)	0	0	0 (0%)
WHW Terrier	1 (0.8%)	0	0	0 (0%)	1	0	1 (100%)	0	0	0 (0%)
Bergmask Sheepdog	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	0	1	1 (50%)
Croatian Sheepdog Tornjak	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	0	1	1 (50%)
English Cocker Spaniel	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	1	0	1 (50%)
Pitt Bull	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	0	1	1 (50%)
Alaskan Malamute	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	0	1	1 (50%)
French Bulldog	1 (0.8%)	0	0	0 (0%)	0	1	1 (100%)	0	0	0 (0%)
Argentinian Mastiff	1 (0.8%)	0	0	0 (0%)	0	0	0 (0%)	1	0	1 (50%)
Total		21	10	31	31	21	52	25	17	42

Table 4. Frequency of tumor grades in relation to the sex and age (number and %) dogs

Grade	Grade I.	Grade II.	Grade III.	Total
Total	31 (24.8%)	52 (41.6%)	42 (33.6%)	125
Male	21 (67.74%)	31 (59.62%)	25 (59.53%)	77 (61.6%)
Female	10 (32.26%)	21 (40.38%)	17 (40.47%)	48 (38.4%)
% Male in total number of male	27.27	40.26	32.47	100
% Female in total number of female	20.83	43.75	35.42	100
Age	7.82	7.69	7.99	7.83

Table 5. Frequency of tumor grades in relation to the location of the tumor on the dogs

Location	Grade I.	Grade II.	Gradus III.	Total
Head	5 (41.67%)	6 (50%)	1 (8.33%)	12 (9.6%)
Neck	3 (37.5%)	2 (25%)	3 (37.5%)	8 (6.4%)
Forelimb	2 (22.22%)	4 (44.44%)	3 (33.33%)	9 (7.20%)
Hind limb	5 (31.25%)	8 (50%)	3 (18.75%)	16 (12.8%)
Thorax	5 (23.80%)	8 (38.10%)	8 (38.10%)	21 (16.8%)
Back	-	2 (100%)	-	2 (1.6%)
Abdomen	3 (20%)	7 (46.67%)	5 (33.33%)	15 (12%)
Perineum	-	-	4 (100%)	4 (3.2%)
Tail	-	1 (100%)	-	1 (0.8%)
Scrotum	1 (20%)	1 (20%)	3 (60%)	5 (4.0%)
Preputium	-	1 (100%)	-	1 (0.8%)
Multiple	-	2 (28%)	5 (71.43%)	7 (5.60%)
Not known	7 (29.17%)	10 (41.66%)	7 (29.17%)	24 (19.2%)
Total	31	52	42	125 (100%)

The dogs with MCSs included 32 breeds, and the most frequently affected breeds were Golden Retrievers (n = 26 or 20.8%), mongrels (n = 19 or 15.2%), and Boxers (n = 14 or 11.2%) (Table 3).

Based on the Patnaik grading system, there were 31 (n = 21 or 67.74% in male dogs; n = 10 or 32.26% in female dogs) diagnosis of grade I MCSs, 52 grade II (n = 31 or 59.61% in male; n = 21 or 40.38% in female) and 42 grade III (n = 25 or 59.53% in male; n = 17 or 40.47% in female). Grade I tumors were found in 24.8%, grade II in 41.6 and grade III in 33.6%. The males were more frequently affected than females. In male and female animals the most frequent grade of MCSs was grade II. The mean ages of the affected animals with grade I, II and III were 7.82, 7.69 and 7.99 respectively (Table 4).

Table 6a. Frequency of mast cell sarcoma in relation to the breed, location of tumor and sex of the dogs

Breed	Golden Retriever	Mongrel	Boxer	Labrador Retriever	Pug	Staffordshire Terrier	Not known	Bullmastiff	Shar Pei	English Setter	
Location of tumors	Head	3 (11.54%) (2M1F)	1 (5.26%) (1M)	1 (7.14%) (1F)	-	-	2 (28.57%) (1F1M)	-	1 (25%) (1M)	-	1 (50%) (1F)
	Neck	3 (11.54%) (2F1M)	2 (10.53%) (2M)	-	1 (8.33%) (1M)	1 (14.29%) (1M)	-	-	-	1 (50%) (1M)	-
	Forelimb	3 (11.54%) (3F)	-	2 (14.29%) (1M1F)	1 (8.33%) (1M)	-	1 (14.29%) (1M)	-	-	-	-
	Hind limb	1 (3.84%) (1F)	1 (5.26%) (1F)	1 (7.14%) (1M)	3 (25%) (2F1M)	2 (28.57%) (2M)	1 (14.29%) (1M)	-	1 (25%) (1M)	1 (50%) (1M)	-
	Thorax	8 (30.77%) (5M3F)	2 (10.53%) (2F)	2 (14.29%) (2M)	1 (8.33%) (1F)	1 (14..29%) (1M)	1 (14.29%) (1M)		2 (50%) (2M)	-	-
	Back	-	-	-	-	-	-	-	-	-	-
	Abdomen	-	3 (15.79%) (2F1M)	3 (21.43%) (3F)	3 (25%) (3F)	-	-	-	-	-	1 (50%) (1M)
	Perineum	-	1 (5.26%) (1M)	-	-	1 (14.29%) (1M)	-	-	-	-	-
	Tail	-	-	1 (7.14%) (1F)	-	-	-	-	-	-	-
	Scrotum	-	1 (5.26%) (1M)	-	1 (8.33%) (1M)	-	1 (14.29%) (1M)	-	-	-	-
	Preputium	1 (3.84%) (1M)	-	-	-	-	-	-	-	-	-
	Multiple	2 (7.69%) (2M)	3 (15.79%) (2M1F)	-	1 (8.33%) (1M)	-	-	1 (25%) (1M)	-	-	-
	Not known	5 (19.23%) (3F2M)	5 (26.32%) (3F2M)	4 (28.57%) (3M1F)	1 (8.33%) (1F)	2 (28.57%) (1F1M)	1 (14.29%) (1F)	3 (75%) (3M)	-	-	-
Total		26	19	14	12	7	7	4	4	2	2

Table 6b. Frequency of mast cell sarcoma in relation to the breed, location and sex of the dogs

Breed	Rottweiller	Maltese	Fox Terrier	Boston Terrier	Bernese Mountain Dog	Lassa Apsso	Gernan Shepherd	Dalmatian	Rhodesian Ridgeback	Doberman	
Location of tumors	Head	-	-	-	-	-	2 (100%) (2M)	-	1 (100%) (1M)	-	-
	Neck	-	-	-	-	-	-	-	-	-	-
	Forelimb	-	-	-	-	-	-	-	-	-	-
	Hind limb	1 (50%) (1F)	1 (50%) (1M)	-	1 (50%) (1M)	-	-	-	-	1 (100%) (1F)	1 (50%) (1F)
	Thorax	-	-	-	-	1 (1M)	-	1 (50%) (1M)	-	-	-
	Back	-	-	2 (100%) (2M)	-	-	-	-	-	-	-
	Abdomen	-	1 (50%) (1M)	-	-	-	-	-	-	-	-
	Perineum	1 (50%) (1F)	-	-	-	-	-	1 (50%) (1M)	-	-	1 (50%) (1F)
	Tail	-	-	-	-	-	-	-	-	-	-
	Scrotum	-	-	-	1 (50%) (1M)	-	-	-	-	-	-
	Preputium	-	-	-	-	-	-	-	-	-	-
	Multiple	-	-	-	-	-	-	-	-	-	-
	Not known	-	-	-	-	1 (1M)	-	-	-	-	-
Total		2	2	2	2	2	2	2	1	1	1

Table 6c. Frequency of mast cell sarcoma in relation to the breed, location and sex of the dogs

Breed	English Basset	Pinscher	Beagle	WHW Terrier	Bergamask Sheepdog	Croatian Sheepdog Tornjak	English Cocker Spaniel	Pitt Bull	Alaskan Malamute	French Bulldog	Argentinian Mastiff	
Location of tumors	Head	-	-	-	-	-	-	-	-	-	-	-
	Neck	-	-	-	-	-	-	-	-	-	-	-
	Forelimb	-	-	-	-	1 (100%) (1F)	-	-	1 (100%) (1F)	-	-	-
	Hind limb	-	-	-	-	-	-	-		-	-	-
	Thorax	1 (100%) (1F)	1 (100%) (1M)	-	-	-	-	-	-	-	-	-
	Back	-	-	-	-	-	-	-	-	-	-	-
	Abdomen	-	-	-	1 (100%) (1M)	-	1 (100%) (1F)	1 (100%) (1F)	-	1 (100%) (1F)	-	-
	Perineum	-	-	-	-	-	-	-	-	-	-	-
	Tail	-	-	-	-	-	-	-	-	-	-	-
	Scrotum	-	-	-	-	-	-	-	-	-	-	1 (100%) (1M)
	preputium	-	-	-	-	-	-	-	-	-	-	-
	Multiple	-	-	-	-	-	-	-	-	-	-	-
	Not known	-	-	1 (100%) (1F)	-	-	-	-	-	-	1 (100%) (1F)	-
Total		1	1	1	1	1	1	1	1	1	1	1

Concerning the localization and grade of MCSs, the most frequent localization was the thorax (n = 21), then the hind limbs (n = 16), the abdomen (n = 15), the head (n = 12), the forelimbs (n = 9), the neck (n = 8), multiple locations (n = 7), the scrotum (n = 5), the perineum (n = 4), the back (n = 2), the tail and preputium equally (n = 1), but in the 24 cases of tumors the localization was unknown. On the thorax the most frequent grades were grades II and III equally, and then grade I, and the percentage was 38.10%, 38.10% and 23.80% respectively; on the hind limb grades II, I and III (50%, 31.25% and 18.75% respectively); on the abdomen grades II, III and I (46.67%, 33.33%, 20% respectively), on the head grades II, I and III (50%, 41.67%, 8.33% respectively), on the forelimb grades II, III and I (44.44%, 33.33% and 22.22% respectively), on the neck grades I and III equally then grade II (37.5%, 37.5% and 25% respectively), in multiple locations grade III and then grade II (71.43%, 28% respectively), on the scrotum grade III and then grade II and I equally (60%, 20%, 20% respectively), and on the perineum only grade III in 4 animals was found (Table 5). The grade differences concerning the various breeds of animals are shown in Tables 6abc.

Discussion

The results of this study reveal some interesting findings regarding the incidence of MCSs, and their distribution according to sex, breed, age and localization in Croatia. Additionally, data concerning the frequency of tumor grades related to the location, breed and sex are also important findings, which can be used in clinical practice. The majority of canine mast cell tumors occur in the skin and subcutis, and most MCSs originate in the dermis and extend into the subcutis, but there is subset that is confined to the subcutaneous fat (NEWMAN et al., 2007; THOMPSON et al., 2011). No histological grading system has been developed for subcutaneous MCSs. The results of THOMPSON'S study (2011) indicate that the majority of subcutaneous MCSs have a favorable prognosis. It is interesting that many pathologists describe subcutaneous MCSs as grade II tumors because of their subcutaneous location (PATNAIK et al,. 1984), but the majority of dogs with subcutaneous MCSs had prolonged survival times, increased disease-free intervals and lower rates of local reoccurrence and metastasis than with grade II cutaneous MCSs, and they are more effectively controlled by surgery than their cutaneous counterparts (THOMPSON et al., 2011). In our study, we analyzed subcutaneous and cutaneous MCSs using the Patnaik grading scheme.

Concerning the overall prevalence of MCSs, our ratio is in concordance with the literature (BRODEY, 1970; PRIESTER, 1973; FINNIE and BOSTOCK, 1979; ROTHWELL, 1987; MISDORP, 2004; BLACKWOOD et al., 2012). Literature data shows that the percentage of MCS was higher in females (intact and neutered) than in males (intact and neutered) dogs (GOLDSCHMIDT and SHOFER, 1998; GROSS et al., 2010). In our study, sex distribution differed from the literature data, i.e. MCSs were more frequently found in

males in comparison to females. The mean age of the affected animals with MCSs was 7.83 years. This is generally in accordance with other literature data (GROSS et al., 2010).

In this study, 32 breeds of dog were affected with MCSs. The most frequent were Golden Retrievers, mongrels, Boxers, and Labrador Retrievers. The literature data described breed predilection to MCSs for a certain breed similar to our dana, but their frequency was different. In our case in first place according to frequency were Golden Retrievers (which is in accordance with the results by NEWMAN et al., 2007) then mongrels, Boxers, Labrador Retrievers, Pugs, Staffordshire Terriers, Bullmastiffs etc. Several authors (GOLDSCHMIDT and SHOFER, 1998; SCOTT et al., 2001; RABANAL and FERRER 2002; GROSS et al., 2010) stated breed predilection for Boxers, Boston Terriers, Bull Terriers, English Bulldogs, Dachshunds, Labrador and Golden Retrievers, Beagles, Pugs, Shar Peis, Rhodesian Ridgebacks and Weimaraners. Similar to our findings, THOMPSON (2011) recorded that Labrador Retrievers are the most affected breed. The previous studies of cutaneous MCSs reported that Boxers frequently develop multiple tumors (KIUPEL et al., 2005) but the outcomes are favorable (LONDON and SEGUIN, 2003). Also Pugs have less aggressive tumors (McNEIL, 2006), which suggests that there may be a genetic component to predisposition and tumor behavior.

Concerning the localization and grade of MCSs, our findings are similar to the results of GOVIER (2003) and SIMPSON et al. (2004). Their data showed that the most frequent locations are the trunk, hind limbs, head and neck. In the work of NEWMAN et al. (2007), the most common locations for subcutaneous tumors are the hind limbs, forelimbs, abdomen, thorax, head/neck, back and tail.

Considering sex predisposition, in our study all grades of mast cell tumors were more common in male animals. In both sexes the most frequent grade of MCSs was grade II. This is an interesting finding because in literature there are no data which describe sex as a risk factor. GROSS et al. (2010) stated that the majority of canine mast cell tumors are grades I and II, but in our study the most frequent grade in males and females was grade II, which is in accordance with some literature data (BUBIĆ ŠPOLJAR, 2007; GRABAREVIĆ et al., 2009). Although the histopathological grade is considered to be the gold standard for diagnosing MCSs, the high ratio of grade II and interobserver variation indicates the weaknesses of the Patnaik grading system. According to the data presented by KIUPEL et al. (2011) the most significant variation in grading was between grades I and II. A 2-grade system of low-grade and high grade may be more appropriate and of greater clinical use. Tumor grades, in relation to the breed of dogs, are very similar to the previously described results (GRABAREVIĆ et al., 2009).

On the basis of our and previously cited literature dana, it is our opinion that in all histopathological analysis both methods („Patnaik's“ and „Kiupel's“) should be used. This finding would be helpful for deciding which method is more applicable for obtaining

a final diagnosis and the grade of the MCTs. Subcutaneous MCTs should be separately analysed because of their different behavior.

Acknowledgements

This study was financed by the Republic of Croatia, the Ministry of Science, Education and Sport, project No. 053-053-2264-2260.

References

BLACKWOOD, L., S. MURPHY, P. BURACCO, J. P. De VOSS, P. DeFORNEL-THIBAUD, J. HIRSCHBERGER, M. KESSLER, J. PASTOR, F. PONCE, K. SAVARY-BATAILLE, D. J. ARGYLE (2012): European consensus document on mast cell tumours in dogs and cats. Vet. Comp. Oncol. 10, 1-29.

BRODEY, R. S. (1970): Canine et feline neoplasia. Adv. Vet. Sci. Comp. Med. 14, 309-354.

BUBIĆ ŠPOLJAR, J. (2007): Histopathological distribution and staging of the dog mast cell tumors depending of the expression of the specific tumor markers. PhD Thesis, Univerity of Zagreb, Zagreb, Croatia.

FINNIE, J. W., D. E. BOSTOK (1979): Skin neoplasia in dogs. Aust. Vet. J. 55, 602-604.

FOX, L. E. (1998): Mast cell tumors. In: Cancer in Dogs and Cats (Morrison,W. B., Ed.) Williams and Wilkins, Baltimore, Philadelphia, London, Paris, Bangkok, Buonos Aires, Hong Kong, Munich, Sydney, Tokyo, Wroclaw.

GIEGER, T., A. P. THÉON, J. A. WERNER, M. C. McENTEE, K. M. RASSNICK, H. E. V. DeCOCK (2003): Muzzle mast cell tumors in dogs: 24 cases (1990.-2001.). J. Vet. Intern. Med. 17, 687-692.

GOLDSCHMIDT, M. H., F. S. SHOFER (1998): Skin Tumors of the Dog and Cat. Butterworth Heinemann, Oxford, Boston, Johannesburg, Melbourne, New Delhi, Singapore. pp.231-251.

GOVIER, S. M. (2003): Principles of treatment for mast cell tumors. Clin. Tech. Small. Anim. Pract. 18, 103-106.

GRABAREVIĆ, Ž., J. BUBIĆ ŠPOLJAR, A. GUDAN KURILJ, I. C. ŠOŠTARIĆ ZUCKERMANN, B. ARTUKOVIĆ, M. HOHŠTETER, A. BECK, P. DŽAJA, N. MALTAR STRMEČKI (2009): Mast cell tumor in dogs-incidence and histopathological characterization. Coll. Antropol. 33, 253-258.

GROSS, T. L., P. J. IHRKE, E. J. WALDER, V. K. AFFOLTER (2010): Mast cell tumors. In: Skin Diseases of the Dog and Cat-Clinical and Histopathologic Diagnosis. 2nd ed.) Blackwell Publishing, pp 853-861.

KIUPEL, M., J. D. WEBSTER, K. L. BAILEY, S. BEST, J. DeLEY, C. J. DETRISAC, S. D. FITZGERALD, D. GAMBLE, P. E. GINN, M. H. GOLDSCHMIDT, M. J. HENDRICK, E. W. HOWERTH, E. B. JANOVITZ, I. LANGOHR, S. D. LENZ, T. P. LIPSCOMB, M. A. MILLER, W. MISDORP, S. MOROFF, T. P. MULLANEY, I NEYENS, D. O'TOOLE, J. RAMOS-VARA, T. J. SCASE, F. Y. SCHULMAN, D. SIEDGE, R. C. SMEDLEY, K. SMITH,

P. W. SNYDER, E. SOUTHORN, N. L. STEDMAN, B. A. STEFICEK, P. C. STROMBERG, V. E. VALLI, S. E. WEISBRODE, J. HELLER, R. MILLER (2011): Proposal of a 2-tier histologic grading sistem for canine cutaneous mast cell tumors to more accurately predict biological behavior. Vet. Pathol. 48, 147-155.

LONDON, C. A., B. SEGUIN (2003): Mast cell tumors in the dog. Vet. Clin. N. Am. Small. Anim. Pract. 33, 473-489.

McNEIL, E. A., A. L. PRINK, T. D. O'BRIEN (2006): Evaluation of risk and clinical outcome of mast cell tumors in pug dogs. J. Vet. Comp. Onc. 4, 2-8.

MILLER, D. M. (1995): The occurrence of mast cell tumors in young Shar-Peis. J. Vet. Diagn. Invest. 7, 360-363.

MISDORP, W. (2004): Mast cells and canine mast cell tumours: a review. Vet. Q. 26, 156-169.

MULLINS, M. N., W. S. DERNELL, S. J. WITHROW, E. J. EHRHART, D. H. THAMM, S. E. LANA (2006): Evaluation of prognostic factors associated with outcome of mast cell tumors treated with surgery with and without adjuvant treatment: 54 cases (1998-2004). J. Am. Vet. Med. Assoc. 228, 91-95.

NEWMAN, S. J., L. MRKONJICH, K. K. WALKER, B. W. ROHRBACH (2007): Canine subcutaneous mast cell tumour: diagnosis et prognosis. J. Comp. Pathol. 136, 231-239.

NORTHRUP, N. C., B. G. HARMON, T. L. GIEGER, C. A. BROWN, K. P. CARMICHAEL, A. GARCIA, K. S. LATIMER, J. S. MUNDAY, P. M. RAKIC, L. J. RICHEY, N. L. STEDMAN, A. L. CHENG, E. W. HOWERTH (2005a): Variation among pathologists in the histologic grading of canine cutaneous mast cell tumors. J. Vet. Diagn. Invest. 17, 245-248.

NORTHRUP, N. C., E. W. HOWERTH B. G. HARMON, C. A. BROWN, K. P. CARMICHAEL, A. GARCIA, K. S. LATIMER, J. S. MUNDAY, P. M. RAKIC, L. J. RICHEY, N. L. STEDMAN, T. L. GIEGER (2005b): Variation among pathologists in the histologic grading of canine cutaneous mast cell tumors with uniform use of single grading reference. J. Vet. Diagn. Invest. 17, 561-564.

O'KEEFE, D. A. (1990): Canine mast cell tumours. Vet. Clin. N. Am. Small. Anim. Pract. 20, 1105-1115.

PATNAIK, A. K., W. J. EHLER, E. G. MacEWEN (1984): Canine cutaneous mast cell tumour: morphologic grading and survival time in 83 dogs. Vet. Pathol. 21, 469-474.

PRIESTER, W. A. (1973): Skin tumors in domestic animals: data from 12 United States and Canadian colleges of veterinary medicine. J. Natl. Cancer Inst. 50, 457-466.

RABANALL, R., L. FERRER (2002): Mast cell tumors: from the molecular biology to the clinic. In: Proceedings of the ISVD Meeting, Nice, pp. 11-26.

ROTHWELL, T. L., C. R. HOWLETT, D. J. MIDDLETON, D. A. GRIFFITHS, B. C. DUFF (1987): Skin neoplasms of dogs in Sydney. Aust. Vet. J. 64, 161-164.

SCOTT, D. W., W. H. MILLER, C. E. GRIFFIN (2001): Muller & Kirks Small Animal Dermatology. 6th ed. W. B. Saunders, Philadelphia. pp. 1320-1330.

SIMPSON A. M., L. L. LUDWIG, S. J. NEWMAN, P. J. BERGMAN, H. A. HOTTINGER, A. K. PATNAIK (2004): Evaluation of surgical margins required for complete exscision of cutaneous mast cell tumors in dogs. J. Am. Vet. Med. Assoc. 22, 236-240.

ŠOŠTARIĆ-ZUCKERMANN, I.-C., K. SEVERIN, M. HOHŠTETER, B. ARTUKOVIĆ, A. BECK, A. GUDAN KURILJ, R. SABOČANEC, P. DŽAJA, Ž. GRABAREVIĆ (2013): Incidence and types of canine tumours in Croatia. Vet. arhiv 83, 31-45.

THOMPSON, J. J., D. L. PEARL, J. A. YAGER, S. J. BEST, B. L. COOMBER, R. A. FOSTER (2011): Canine subcutaneous mast cell tumor: Characterization and prognostic indices. Vet. Pathol. 48, 156-168.

WITHROW, S. J. (1996): Why worry about cancer in pet animals? In: Small Animal Clinical Oncology (Withrow S. J., E. G. MacEven, Eds.) W. B. Saunders Company, Philadelphia, London, Toronto, Montreal, Sydney, Tokyo.

Received: 26 November 2013
Accepted: 11 July 2014

ARTUKOVIĆ, B., L. MEDVEN, M. HOHŠTETER, I.-C. ŠOŠTARIĆ-ZUCKERMANN, A. GUDAN KURILJ, A. BECK, D. HUBER, D. GRABAREVIĆ, K. SEVERIN, Ž. GRABAREVIĆ: Učestalost mastocitoma u pasa u Hrvatskoj. Vet. arhiv 84, 601-614, 2014.

SAŽETAK

Na Zavodu za veterinarsku patologiju Veterinarskog fakulteta u Zagrebu istraživana je pojavnost mastocitoma koji nastaju od tkivnih mastocita u dermisu i supkutisu u razdoblju od 1. siječnja 2008. do 31. prosinca 2012. godine. Utvrđena je njihova pojava ovisno o spolu, pasmini, dobi i lokaciji te učestalost pojedinog stupnja tumora ovisno o pasmini, spolu i lokaciji. U analiziranom razdoblju zabilježeno je ukupno 1939 tumora od kojih je bilo 928 tumora kože, a mastocitomi su utvrđeni u 125 životinja odnosno 13,47% od ukupnog broja tumora kože. Mastocitomi su bili najčešći u muških životinja (n = 77 ili 61,6%) prosječne dobi 7,83 godine. Pojavnost tumora bila je najčešća na toraksu (16,8%), stražnjim udovima (12,8%), trbuhu (12%), prednjim udovima (7,20%) i vratu (6,4%). Najveća učestalost mastocitoma bila je u zlatnog retrivera. Stupanj I. tumora utvrđen je u 24,8% slučajeva (n = 31) od kojih su 67,74% bili mužjaci (n = 21), a 32,26% (n = 10) ženke; stupanj II. tumora u 41,6% (n = 52) od kojih su 59,62% (n = 31) bili mužjaci, a 40,38% (n = 21) ženke; stupanj III. tumora je utvrđen u 33,6% (n = 42) od kojih je 59,53 (n = 25) bilo mužjaka i 40,44 (n = 17) ženki. Udio stupnja I., II. i III. u mužjaka je bio retrospektivno 27,27%; 40,26% i 32,47%, a u ženki 20,83%; 43,75% and 35,42%. Prosječna dob životinja s tumorom stupnja I. iznosila 7,82 godine, stupnja II. 7,69, a s tumorom stupnja III. 7,99 godina. Na glavi je najčešće zabilježen stupanj II. tumora, na vratu podjednako stupanj I. i III., na prednjim i stražnjim udovima, leđima, trbuhu, repu i prepuciju najčešći je bio stupanj II. tumora dok je III. stupanj bio najčešći na perineumu, skrotumu te na multiplim lokacijama. U zlatnog retrivera tumor je najčešće bio ustanovljen na grudnom košu, u boksera na trbuhu, a u križanaca na različitim mjestima po tijelu.

Ključne riječi: mastocitomi, koža, učestalost, psi, Hrvatska