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NEOPLASTIC DISEASE

Swiss Canine Cancer Registry 1955—2008: Occurrence of the Most Common Tumour Diagnoses and Influence of Age, Breed, Body Size, Sex and Neutering Status on Tumour Development

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Summary

This study is based on the Swiss Canine Cancer Registry, comprising 121,963 diagnostic records of dogs compiled between 1955 and 2008, in which 63,214 (51.83%) animals were diagnosed with tumour lesions through microscopical investigation. Adenoma/adenocarcinoma ($n = 12,293$, 18.09%) was the most frequent tumour diagnosis. Other common tumour diagnoses were: mast cell tumour ($n = 4,415$, 6.50%), lymphoma ($n = 2,955$, 4.35%), melanocytic tumours ($n = 2,466$, 3.63%), fibroma/fibrosarcoma ($n = 2,309$, 3.40%), haemangioma/haemangiosarcoma ($n = 1,904$, 2.80%), squamous cell carcinoma ($n = 1,324$, 1.95%) and osteoma/osteosarcoma ($n = 842$, 1.24%). The relative occurrence over time and the most common body locations of those tumour diagnoses are presented.

Analyses of the influence of age, breed, body size, sex and neutering status on tumour development were carried out using multiple logistic regression. In certain breeds/breed categories the odds ratios (ORs) for particular tumours were outstandingly high: the boxer had higher ORs for mast cell tumour and haemangioma/haemangiosarcoma, as did the shepherd group for haemangioma/haemangiosarcoma, the schnauzer for squamous cell carcinoma and the rottweiler for osteoma/osteosarcoma. In small dogs, the risk of developing mammary tumours was three times higher than in large dogs. However, small dogs were less likely to be affected by many other tumour types (e.g. tumours of the skeletal system).

Examination of the influence of sex and neutering status on tumour prevalence showed that the results depend on the examination method. In all sampling groups the risk for female dogs of developing adenoma/adenocarcinoma was higher than for male dogs. Females had a lower risk of developing haemangioma/haemangiosarcoma and squamous cell carcinoma than males. Neutered animals were at higher risk of developing specific tumours outside the genital organs than intact animals.

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The sample size allows detailed insight into the influences of age, breed, body size, sex and neutering status on canine tumour development. In many cases, the analysis confirms the findings of other authors. In some cases, the results are unique or contradict other studies, implying that further investigations are necessary.

Introduction

To meet the challenge posed by the combination of potential aetiological factors in cancer, patient data and diagnoses need to be explored systematically (MacVean *et al.*, 1978; Brønden *et al.*, 2007, 2010; Vascellari *et al.*, 2009; Dobson, 2013; Waters *et al.*, 2014). This is the cornerstone of any epidemiological study of cancer that aims to investigate cancer development patterns in defined populations over time and space. The epidemiological study of cancer is therefore dependent on the availability of patient data, which are usually stored in cancer registries.

In this context, the study of companion animal cancer registries is especially valuable. Firstly, companion animals and their owners share the same environment and are therefore mostly exposed to the same environmental cancer risk factors (Bukowski and Wartenberg, 1997; Backer *et al.*, 2001; Gamlem *et al.*, 2008; Marconato *et al.*, 2009; Bettini *et al.*, 2010). Secondly, similar genetic predisposing factors for cancer development have been found for man and animals (Jónasdóttir *et al.*, 2000; Patterson, 2000; Lingaas *et al.*, 2003; Breen, 2009; Pastor *et al.*, 2009; Phillips *et al.*, 2010; Ke *et al.*, 2011). For instance, canine renal cystadenocarcinoma and nodular dermatofibrosis (Jónasdóttir *et al.*, 2000; Lingaas *et al.*, 2003) and canine osteosarcoma (Phillips *et al.*, 2010) are well-known examples of syndromes linked to genetic conditions common to both dogs and man. The former complex was linked to a specific mutation also found in people affected by a similar syndrome; in the latter a linkage to a specific locus was found in both species. These findings underline the value of comparative studies in human and veterinary oncology as part of the 'One Health' concept (Breen, 2009).

The present study is based on the Swiss Canine Cancer Registry (Grüntzig *et al.*, 2015) and highlights the influences of age, breed, body size, sex and neutering status on the development of tumours in dogs. The size of the Swiss Canine Cancer Registry, which comprises 121,963 dogs and 67,943 tumour diagnoses, allows computation of meaningful statistics. To our knowledge, the Swiss Canine Cancer Registry is the most comprehensive animal cancer registry at a national level.

Materials and Methods

Data Source

The data originated from the Swiss Canine Cancer Registry (Grüntzig *et al.*, 2015) comprising 121,963 diagnostic records of dogs provided by three veterinary diagnostic laboratories in Switzerland: the Vetsuisse Faculty Institut für Veterinärpathologie, Zürich (IVPZ), the Vetsuisse Faculty Institut für Tierpathologie, Bern (ITPA) and the Zyto/Histo Diagnostik private veterinary diagnostic laboratory (based in Rorbas Freienstein). The data sets included diagnostic records from canine samples generated by three different examination methods: post-mortem analysis (and subsequent histopathological evaluation), biopsy sampling (with subsequent histopathological examination) and cytology. Biopsy and cytology samples are hereafter called ex-vivo samples. No cases were excluded; however, some parameters were missing due to incomplete reporting by the submitting veterinarians. All diagnoses in the Swiss Canine Cancer Registry were derived from a microscopical examination.

Data Preparation

In different time periods, different terms were used for the description of age, breed, sex and neutering status. Those differences were standardized by numerical coding. The diagnoses were then coded according to the tumour topographical and morphological keys of the ICD-O-3 (Fritz *et al.*, 2013) and checked for plausibility using the original patient records. All tumour diagnoses were based on either histopathological or cytological examination. Epidermal cysts were excluded.

The data included 215 castrated male dogs with tumours in the testes. Since it is common in those cases to castrate the patient while sampling the tumour, those dogs where re-classified as entire at the moment of tumour diagnosis.

Data sets missing the information on the sex and/or status of neutering of patients were excluded from the