Feline (sub)cutaneous neoplasia:

A retrospective study based on cytology data

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Abstract

A total of 3,820 cases (19.94%) of (sub)cutaneous neoplasia were diagnosed in 19,161 feline cases submitted for cytological examination from veterinary practices in the Netherlands. Twelve categories of neoplasia were defined and four of these categories compromised 64.4% of the cases. These were (adeno)carcinoma (n=821, 21.5%, mean age 13.10 ± 3.16, median age 13.54); "mesenchymal proliferation, suspect sarcoma" (n= 809, 21.2%, mean age 11.77 ± 3.93, median age 12.06); squamous cell carcinoma (n= 460, 12.0%, mean age 13.63 ± 3.19, median age 13.88) and benign epithelial proliferation (n= 370, 9.7%, mean age 10.05 ± 5.16, median age 11.08). For each of these tumors, peak number of cases occurred between 10 and 15 years. The mammary gland was the most common anatomical location for the (adeno)carcinoma, the head for the benign epithelial proliferations and squamous cell carcinoma and the limb for the "mesenchymal proliferation, suspect sarcoma". The (adeno)carcinoma is significantly more likely in female cats (RR=1.86), the mammary gland (RR=4.05) and the Siamese cat (RR=2.06). The "mesenchymal proliferation, suspect sarcoma" is significantly more likely at the limb (RR=2.54) and the European Shorthair (RR=1.91) compared to the pedigree breeds. The benign epithelial proliferation is significantly more likely at female cats (RR=1.60) and Norwegian Forest cat (RR=2.66). Squamous cell carcinoma significant more likely at the head (RR=10.55).
Data from this study will help the veterinarian in making evidence-based decisions in the clinical management of cats with (sub)cutaneous masses.

Key words: cat; feline; (sub)cutaneous neoplasms; (adeno)Carcinoma; Benign epithelial proliferation; mesenchymal proliferation, suspect sarcoma; squamous cell carcinoma.

Introduction

The cat is a commonly kept pet in the Dutch households. It is therefore important to understand diseases this species can have. There is a high occurrence of neoplasia, both malignant and benign variants, in cats [1]. A common group of neoplasia in cats is the group of neoplasms arising from the skin and the subcutaneous tissues [2,3,4]. Unfortunately, there are a few epidemiologic studies available of the analysis of the division of this group of neoplasia in the cat and cytology in particular [5].

A study using histopathology as the diagnostic method, carried out in 1991, showed that 340 (9.54%) out of 3,564 cats were affected by some form of cutaneous neoplasia, and listed specific data including: the histopathological diagnosis, anatomical location of the lesion, age at diagnosis, sex and breed [2] (Table 1). This study however, concerned a population of animals from the United States of America and contained data that is already over 28 years old, making it unclear whether these data are relevant to the Dutch cat population. A further disadvantage is that this study reports a mere 340 cats/tumors, which may limit the results of this study. This is a small number, given the popularity of the cat as a pet (for many years the number of cats has surpassed the number of dogs kept as pets in the Netherlands) and the fact that cutaneous tumors represent a very common group of cancer [2]. For comparison, a more recent (2002) study in the dog was conducted, under 1,139,616 dogs, of which 25,996 (2.28%) had some form of cutaneous neoplasia. This study is based on histopathologic analysis [6]. Another recently published article (2016) contained information on (sub)cutaneous neoplasms, in cats from Switzerland. 7,629 (41.52%) of 18,375 tumors

Year	Land	1	2	3	4
1991[2]	USA	Basal cell tumor	Mast cell tumor	Squamous cell carcinoma	fibrosarcoma
2016[1]	Switzerland	Fibrosarcoma	Basal cell tumor	Squamous cell carcinoma	Mast cell tumor
2018[3]	United Kingdom	Basal cell tumor	Fibrosarcoma	Squamous cell carcinoma	Mast cell tumor

Table 1: The most common histopathological diagnoses in the reported feline (subcutaneous neoplasia studies [1,2,3].

were located in the skin, with 5,804 (76.08%) being malignant [1] (Table 1). A more recently published article (2018) also contains information about the distribution of cutaneous tumors of cats in the United Kingdom (Table 1). This article was also based on histopathological diagnoses [3]. Of the 219,083 feline samples, 4,4% were located on/in the skin, and 52.7% of these were malignant [3]. These three articles on feline cutaneous neoplasia, show that date on the distribution of feline cutaneous neoplasia are almost exclusively based on histopathology and does not assess the potential role of cytology in the diagnosis of feline cutaneous neoplasia.

Histopathology is considered the gold standard, but this method requires an invasive procedure (surgical biopsy) under (local) anesthesia and is expensive [7]. Cytology however is much quicker and less expensive and can help the veterinarian in making the appropriate recommendations to an owner, with regards to further diagnostic and therapeutic options, as well as prognosis. Although histopathology is the best method to accurately characterize the various types of cancer, cytology is excellent in diagnosing hematopoietic neoplasia and helpful in epithelial and mesenchymal proliferations. Several studies have shown an excellent (>90%) agreement between the histopathological and cytological diagnoses of (sub)cutaneous neoplasia in both dog and cat. There are several ways to collect cytological specimens for microscopic examination. Fine needle aspiration is a commonly used method by veterinarians [8,9,10]. Cytology samples are typically easy to collect, do not require the need for (local) anesthesia and analgesia [8]. Cytology gives quick results and may prevent the need for more invasive diagnostic procedures such as a histological biopsy [8,9].

Cytological samples can be non-diagnostic (poorly to acellular, cellular debris), but in case of a diagnostic sample, the first step is to characterize the sample as inflammatory or non-inflammatory based on the presence or absence of the various inflammatory cells [8]. In case of non-inflammatory samples, the proliferation is often neoplastic and characterized by the predominant cell population as either epithelial, mesenchymal or round-cells [4,8,11]. Cytology will often allow for differentiation between benign and malignant epithelial proliferations based on cellular characteristics for malignancy such as anisocytosis, karyomegaly, anisokaryosis, multi/bi/multiple/elongated nucleoli and nuclei and nucleus/cytoplasm ration, and more [8]. Furthermore, cytology is particularly useful in diagnosing round cell tumors, including cutaneous mast cell tumors, (a)melanocytic neoplasia, histiocytic tumors, (muco)cutaneous plasma cell tumors and lymphoma, each of which have a very distinctive cellular morphology [4,8]. Both epithelial and hematopoietic tumor cells typically exfoliate well, in contrast to most mesenchymal proliferations [4,8].

There are a number of potential limitations with cytology. A first concern is the limitation of collecting a sufficiently cellular spicemen, but this problem may be solved by obtaining multiple samples or resampling [9]. Unfortunately, not all malignant neoplasia show notable cellular atypia and not all benign

tumors show minimal cellular atypia [10]. Another issue is the fact that inflammation can induce mesenchymal and epithelial cells to undergo dysplasia or hyperplasia, and thereby mimic the neoplastic transformations in cytological samples [10]. Therefore, when only inflammatory cells are observed, an inflamed neoplasia can not be ruled out [9]. And finally, there is the problem that mesenchymal proliferations typically exfoliate poorly and are notoriously difficult to characterize as reactive or neoplastic and in case of neoplasia as malignant or benign [9]. With the cytology technique fine needle aspiration, it is possible that the needle is inserted beside the tumor and collect a sample with cells of, for example an lymph node [9]. This can lead to false-negative results. This method had a higher positive predictive value, which means that the presence of neoplasia cells is more reliable than the absence of these cells [12].

It is conceivable that cytology and histopathology might result in different diagnoses based on individual clinician's preference which biopsy technique to use and the limitations of cytological analysis. The most common diagnoses in histopathological studies are: basal cell tumor, mast cell tumor, squamous cell carcinoma and fibrosarcoma.[2,3] Because of the lack of cytology studies, there are no data available of most common cytological diagnoses and how they relate to the histopathological diagnoses.

The goal of the study was to analyze cytological diagnoses of cutaneous and subcutaneous lesions in the cats and neoplasia in particular.

Material and Methods

The data for the study were extracted from the cytology database from a single commercial diagnostic laboratory (UVDL) and spanned ten years (2007-2017).

The database was searched to identify all records of feline cytology samples submitted to the cytology service over the past ten years. The results of this query were exported as a database-file (Excel). In order to obtain a reference population, age, breed and sex distribution were calculated from the entire data set.

In order to select the cats with (sub)cutaneous masses all samples originating from the oral, thoracic and abdominal cavity, internal organs, effusions, CSF, BAL, urine, synovia and bone marrow were excluded from the database. Keywords used in the submission forms to exclude cases were: abdominal, thorax, bladder, liver, heart, intestine, bone marrow, thyroid, spleen, pericardium, colon, urine, palate, long, kidney, stomach, ascites, tongue, lymph node (Lnn), mouth and trachea. Only when the location lymph node was certain, the record was eliminated from the database. The resulting set of data consisted almost exclusively of palpable (sub)cutaneous masses. These submissions were characterized in 6 gross disease categories (Table 2) and in case of neoplasia subcategorized in a more specific cancer diagnosis (Table 3). When available, anatomic location (Table 4) and in some cases sublocation (Tables 5 and 6) were recorded as well. In case of multiple diagnoses, only the primary/most important diagnosis was recorded, meaning that every cat could only have a single diagnosis.

Inflammation
Cyst, Hematoma, Secretion
Fat, Blood/Not diagnostic
Reactive Lymphoid Tissue
Neoplasia
Undefined diagnoses

Table 2: List of gross disease categories

In cases of epithelial neoplasia, the following sub-diagnoses were selected (Table 3): "benign epithelial tumor", "(adeno)carcinoma" and "squamous cell carcinoma". The category benign epithelial proliferation contains fibro-adenomatoid hyperplasia, basal cell tumors and adenomas.

Given the inherent limitations of cytology in accurately classifying mesenchymal proliferations, two sub-diagnoses, being "mesenchymal proliferation, suspect sarcoma" and "mesenchymal proliferation suspect inflammation" were recorded next to the specific diagnosis of (injection-site)sarcoma. The category mesenchymal proliferation also contained the sub-diagnosis lipoma. In the category round

cell neoplasia, the categories “melanocytic proliferation”, “mast cell tumor”, “lymphoma” and “suspect lymphoma” were identified.
The category “other/undefined diagnoses” contained all sub-diagnoses that were either uncommon, undefined or could not be included in a category. This category contains the histiocytomas, fibromas, plasma cell tumors, hemangiopericytomas and histiocytic sarcomas.

Epithelial
Benign epithelial proliferation
(adeno)Carcinoma
Squamous cell carcinoma
Mesenchymal
(injection-site)Sarcoma
Mesenchymal proliferation, suspect sarcoma
Mesenchymal proliferation, suspect Inflammation
Lipoma
Round cell
Melanocytic proliferation
Mast cell tumor
Lymphoma
Suspect Lymphoma
Other neoplasia
Other or undefined diagnoses

Table 3: List of specific cancer diagnoses

The anatomical locations of the cases with the diagnosis neoplasia, were recorded and in cases of multiple tumors, only a single location was recorded.

Head
Neck
Limb
Thoracic wall
Abdominal wall
Back
Mammary gland
Perineum
Tail
Unknown

Table 4: List of locations

For the location “Head” and “Limb, it was possible to add a further sublocation (Table 5, 6).

Nose
Lip
Eye
Ear
Jaw
Cheek
Chin

Table 5: List of sublocation Head

Shoulder
Upper arm (Elbow/Axilla)
Lower arm (Carpus/Metacarpus)
Toe/Foot Pads
Buttock/Hip
Upper leg
Lower leg (Knee)
Tarsus/Metatarsus

Table 6: List of sublocation Paw

Based on the initial analysis of all cytology submissions the most common breeds were identified.
For sex and age the following categories were made (Tables 7, 8).

Male
Male neutered
Female
Female neutered
Hermaphrodite
Unknown/Not reported

Table 7: List of sex categories

Age was calculated by subtracting “date of birth” when recorded from “date of sample submission”. Ages of ≤0,0 and ≥28 were excluded from further analysis due to the high likelihood of inappropriate recording of either of these dates.

0 - < 5 years
5 - < 10 years
10 - < 15 years
15 - < 20 years
20 - < 25 years
25 - < 30 years

Table 8: List of age categories

Analyses of age, breed, sex and diagnosis were made. Age, breed, sex and anatomical location were evaluated for each of the different

tumor types. A second analysis was performed by comparing pedigree cats with the European (ESH)/Domestic Shorthair (DSH). The most common results are based on percentages.

The first step in statistical analysis were the descriptive statistics. Statistical analysis was also performed by applying chi-square analysis for discrete data and a one-way ANOVA with Bonferroni correction for continuous and normally distributed data, using SPSS 24 for Windows. With the outcome of the chi-square analysis, the relative risk (RR) was calculated. The RR was calculated for the most notable data. The Odds ratio is used to calculate the increased (>1) of decreased odds (<1). Data with a $p<0.05$ were considered significant.

Results

The initial query from the UVDL database generated in 19,161 feline cytology cases of which 8,431 cats fulfilled the study criteria. Of these 8,431 cases, 3,820 cats had a lesion consistent with (sub)cutaneous mass, accounting for 19.94% of all cytology submissions to the UVDL.

The entire studied population (n=19.161) consisted of 36 cat breeds, of which 6 were the most common and accounted for 94.2% of the used population of cats.

The six most common breeds were the European Shorthair 82.4% (n=15,797), Maine Coon 3.7% (n=711), British Shorthair 2.7% (n=523), Persian cat 2.2% (n=415), Siamese cat 1.7% (n=317), Norwegian Forest cat 1.5% (n=286) which accounted for 94.2% of all submissions. The remaining pedigree cats represented 30 different breeds and were for the purpose of statistical analysis grouped as “Other breeds”. The entire population consisted of 47.4% (n=9,073) neutered males, 39,9% (n=7,643) neutered females, 5.2% (n=1,001) sexually intact females, 3.9% (n=742) sexually intact males, 3.6% (n=689) cats of unknown sex and 13 hermaphrodites. The mean age of all cats was 10.6 ± 4.65 years and the most frequent age group was 10-<15 years (43.9%;n=8,128) followed by 5-<10 years (24%;n=4,438), 15-<20 years (17% ;n=3,147), 0-<5 years (14.8%;n=2,740), 20-<25 years (0.3%;n=64) and 1 cat was 28 years (25-<30 years;0%;n=1).

Of the 8,431 cats that fulfilled the study criteria, the breed distribution was European Shorthair 85.1% (n=7,175), Maine Coon 3.1% (n=263), British Shorthair 2.2% (n=184), Persian cat 2.1% (n=179), Siamese cat 1.7% (n=142), Norwegian Forest cat 1.0% (n=87) and Other breeds 4.8% (n=401). Of these cats, 45.0% (n=3,792) were neutered males, 42.2% (n=3,558) neutered females, 6.0% (n=509) sexually intact females, 3.3% (n=276) sexually intact males, 3.4% (n=288) cats of unknown sex and 8 of the cats were hermaphrodite. The mean age was 11.12 ± 4.41 years and the most frequent age group was 10-<15 years (45.4%;n=3,688), followed by 5-<10 years (23.8%;n=1,930), 15-<20 years (19.2% ;n=1,560), 0-<5 years (11.2%;n=906), 20-<25 years (0.4%;n=31) and one cat was 28 years (25-<30 years;0%;n=1).

The most common disease categories among the 8,431 cats were neoplasia 45.3% (n=3,820), followed by Fat/Blood/Not diagnostic 16.6% (n=1,396), Inflammation 16.1% (n=1,359), Reactive lymphoid tissue 6.0% (n=509), Cyst/Hematoma/Secretion 5.8% (n=491) and some of the diagnosis which were undefined 10.2% (n=856).

Of the 3,820 cats, with a (sub)cutaneous neoplastic mass, the breed distribution was European Shorthair 85.5% (n=3,266), Maine Coon 2.9% (n=109), British Shorthair 2.1% (n=82), Persian cat 2.0% (n=77), Siamese cat 1.9% (n=74), Norwegian Forest cat 1.0% (n=39) and Other breeds 4.5% (n=173) (Table 9). Of these cats, 44.2% (n=1,688) were neutered females, 43.1% (n=1,645) neutered males, 6.3% (n=240) sexually intact females, 3.1% (n=118) sexually intact males, 3.3% (n=125) cats of unknown sex and 4 hermaphrodites (Table 9).

The mean age in this group was 12.04 ± 3.96 years and the most frequent age group was 10-<15 years (50.0%;n=1,846), followed by 15-<20 years (23.2%;n=858), 5-<10 years (20.4%;n=754), 0-<5 years (5.8%;n=214), 20-<25 years (0.5%;n=19) and 1 cat was 28 years (25-<30 years;0%;n=1) (Figure 1,Table 8).

The mean age at which the cats were presented with a neoplastic mass, differed between pure breed cats and the Domestic

Shorthair, as well as between the various pure-breed cats (Table 9). The Maine Coon has the youngest mean age 9,17 ± 4.37 and this mean significantly differs from the mean of the European Shorthair ($p<0.001$) (Table 9). The European Shorthair had the oldest mean 12.30 ± 3.83 (Table 9). Table 10 summarizes the different breeds and the most common neoplasms in/on these breeds.

Eleven groups of neoplasms were identified (Table 11). The distributions of sex, age and location for each of these neoplasms is summarized in Tables 11, 12 and Figures 2, 7 and 8. The four most common sub-diagnoses were (adeno)carcinoma, mesenchymal proliferation suspect sarcoma, squamous cell carcinoma and benign epithelial proliferation. An overview of the distribution in neoplastic diagnosis by breed, location, sub-diagnosis and age is presented in tables 14, 15, 16, 17, 18 and 19.

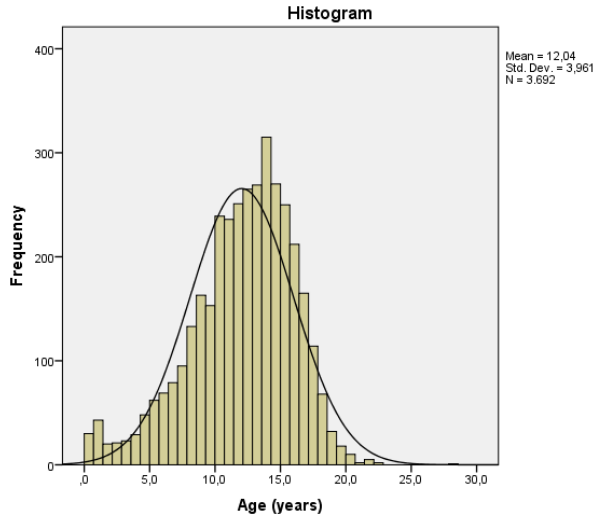


Figure 1: age (years) distribution and histogram of 3.820 cats

Breed	Number of cats (%)	Male:Female	Mean age ± SD (range) (years)	95% = CI	Difference in mean age of breed of breed compared to European Shorthair	Median age
European Shorthair	3266 (85.5%)	1:1.06 (1527:1622)	12.30 ± 3.83 (0.1-28.0)	12.17-12.44		12.79
Maine Coon	109 (2.9%)	1:1.26 (46:58)	9.17 ± 4.37 (0.3-16.8)	8.34-10.00	<0,001	9.92
British Shorthair	82 (2.1%)	1:1.03 (39:40)	11.01 ± 4.23 (0.4-20.4)	10.07-11.95	0.069	11.36
Persian cat	77 (2.0%)	1:1.24 (34:42)	12.23 ± 4.32 (0.7-19.3)	11.23-13.22	1.000	13.51
Siamese cat	74 (1.9%)	1:1.18 (34:40)	11.29 ± 3.49 (1.4-19.0)	10.46-12.11	0.626	11.29
Norwegian Forest cat	39 (1.0%)	1:1.17 (18:21)	10.07 ± 4.20 (1.2-18.1)	8.71-11.43	0.008	9.86
Other breeds	173 (4.5%)	1:1.46 (65:95)	10.17 ± 4.45 (0.4-19.1)	9.50-10.85	<0.001	10.73

Table 9: Distribution of breed: number of cats (%), male:female, mean age of breed ± SD, the 95%-confidence interval (95% CI) of the mean age and age significance of the breeds (pedigree breeds against the control European Shorthair).

Breed	(adeno) Carcinoma (n=821)	Mesenchymal proliferation, suspect sarcoma (n=809)	Squamous cell carcinoma (n=460)	Benign epithelial proliferation (n=370)	Lymphoma (n=288)	(injection-site)Sarcoma (n=256)	Mast cell tumor (n=251)	Mesenchymal proliferation, suspect Inflammation (n=148)	Melanocytic proliferation (n=99)	Lipoma (n=84)	Suspect Lymphoma (n=79)	Other/ undefined diagnoses (n=155)
European Shorthair (n=3266)	20.1%	22.7%	13.1%	9.0%	7.0%	7.1%	5.9%	4.2%	2.8%	2.0%	1.9%	4.2%
Maine Coon (n=109)	17.4%	16.5%	5.5%	21.1%	13.8%	4.6%	11.0%	1.8%	0.9%	0.9%	3.7%	2.8%
British Shorthair (n=82)	28.0%	17.1%	3.7%	12.2%	11.0%	4.9%	11.0%	2.4%	2.4%	2.4%	2.4%	2.4%
Persian cat (n=77)	32.5%	10.4%	16.9%	13.0%	2.6%	5.2%	6.5%	2.6%	3.9%	1.3%	2.6%	2.6%
Siamese cat (n=74)	37.8%	5.4%	2.7%	8.1%	18.9%	1.4%	16.2%	0.0%	0.0%	1.4%	4.1%	4.1%
Norwegian Forest cat (n=39)	12.8%	20.5%	5.1%	25.6%	7.7%	12.8%	5.1%	5.1%	2.6%	2.6%	0.0%	0.0%
Other breeds (n=173)	37.0%	9.2%	3.5%	10.4%	8.7%	3.5%	11.0%	1.2%	1.2%	6.9%	3.5%	4.0%

Table 10: the percentage of subdiagnosis in the different breeds. Other breeds is the category containing the other pedigree breeds.

Neoplasms	Number of cats (%)	Male:Female	Age mean ±SD (range) (years)	95% = CI	Median age
(adeno)Carcinoma	821 (21.5%)	1:1.86 (276:514)	13.10 ± 3.16 (3.1-22.0)	12.88-13.32	13.54
Mesenchymal proliferation, suspect sarcoma	809 (21.2%)	1:0.92 (407:376)	11.77 ± 3.93 (0.3-21.9)	11.49-12.05	12.06
Squamous cell carcinoma	460 (12.0%)	1:1.09 (212:230)	13.63 ± 3.19 (0.6-28.0)	13.33-13.93	13.88
Benign epithelial proliferation	370 (9.7%)	1:1.59 (138:220)	10.05 ± 5.16 (0.2-21.9)	9.51-10.59	11.08
Lymphoma	288 (7.5%)	1:0.67 (169:114)	11.41 ± 3.89 (0.7-22.7)	10.95-11.87	11.56
(injection-site)Sarcoma	256 (6.7%)	1:0.87 (129:112)	11.55 ± 3.86 (0.4-22.4)	11.07-12.04	11.95
Mast cell tumor	251 (6.6%)	1:0.79 (135:107)	11.47 ± 4.22 (0.1-22.0)	10.93-12.00	11.64
Mesenchymal proliferation, suspect Inflammation	148 (3.9%)	1:0.84 (80:65)	11.36 ± 3.93 (2.0-18.1)	10.72-12.01	11.55
Melanocytic proliferation	99 (2.6%)	1:1.41 (41:58)	12.83 ± 3.48 (1.7-20.2)	12.13-13.54	12.98
Lipoma	84 (2.2%)	1:0.74 (46:34)	10.66 ± 3.98 (0.9-17.7)	9.78-11.53	11.53
Suspect Lymphoma	79 (2.1%)	1:0.67 (45:30)	11.39 ± 3.92 (0.9-17.3)	10.49-12.28	11.97
Other/undefined diagnoses	155 (4.1%)	1:0.8 (85:68)	12.14 ± 3.59 (0.1-19.9)	11.56-12.73	11.53

Table 11: Distribution of neoplasms: Number of cats (%), male:female, mean of age ± SD and confidence interval of the mean.

Type neoplasm (n)	Head %	Neck %	Limb %	Thoracic wall %	Abdominal wall %	Back %	Mammary gland %	Perineum %	Tail %	Unknown %
(adeno)Carcinoma (821)	22.9	7.6	19.2	4.5	6.8	1.8	29.5	3.2	0.9	3.7
Mesenchymal proliferation, suspect sarcoma (809)	12.1	7.0	50.6	9.6	8.4	4.7	1.6	0.2	1.6	4.1
Squamous cell carcinoma (460)	81.3	6.3	8.3	0.2	0.9	0.4	0.4	0.4	0.2	1.5
Benign epithelial proliferation (370)	25.4	10.3	14.9	5.1	8.1	4.3	22.4	0.8	4.6	4.1
Lymphoma (288)	34.4	30.2	18.4	4.2	5.9	1.4	1.7	1.7	0.0	2.1
(injection-site)Sarcoma (256)	11.7	7.0	51.2	12.5	7.4	4.7	1.2	0	2.3	2.0
Mast cell tumor (251)	39.8	6.4	26.7	4.4	8.8	2.0	0.8	0.8	4.4	6.0
Mesenchymal proliferation, suspect Inflammation (148)	16.2	8.8	40.5	10.8	12.2	8.8	0.7	0.0	0.0	2.0
Melanocytic proliferation (99)	54.5	12.1	15.2	5.1	3.0	1.0	0.0	0.0	2.0	7.1
Lipoma (84)	0.0	6.0	34.5	19.0	23.8	6.0	4.8	1.2	0.0	4.8
Suspect Lymphoma (79)	26.6	40.5	20.3	3.8	5.1	1.3	0.0	0.0	0.0	2.5
Other/undefined diagnoses (155)	21.3	16.8	43.2	5.8	5.2	1.3	1.3	0.0	1.3	3.9

Table 12: the percentage of the sub-diagnosis at the different anatomical locations.

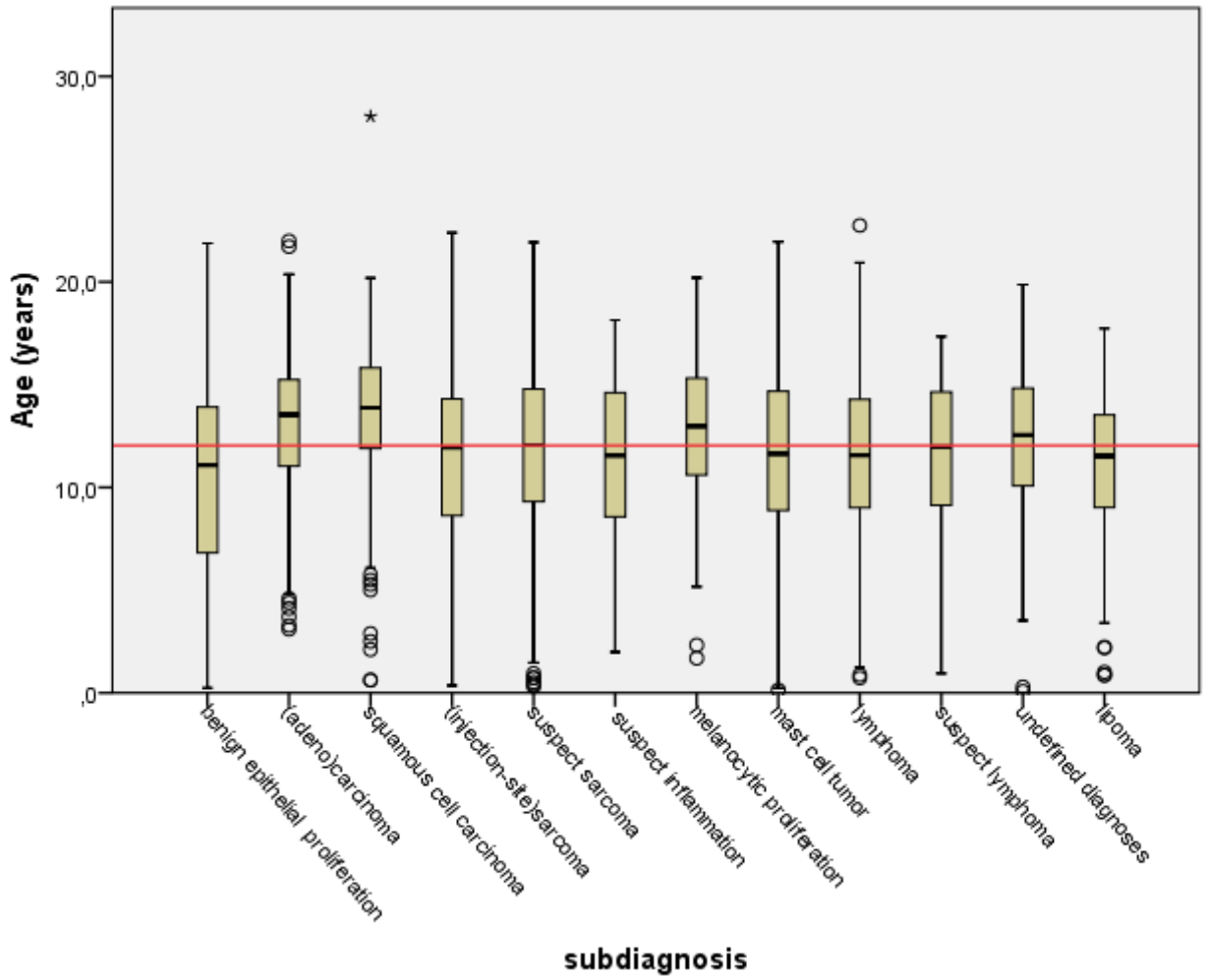


Figure 2: boxplots of the age in years of the different sub-diagnoses. Containing the mean age, the confidence interval, the range and the outliers. The red line is the overall mean.

(adeno)Carcinoma

(adeno)Carcinoma (n=821) was the most common neoplasm and was diagnosed in 21.5% of all cats. There were 276 male and 514 female cats with this specific diagnosis (Table 11). (adeno)Carcinoma was significantly more likely in female cats (RR = 1.8, p<0.001) than in male cats, based on 8135 cats. The mean age at diagnosis was 13.10 ± 3.16 years and the median age was 13.54 (Table 11). The mammary gland was the most common location 29.5% (n=242), followed by the head 22.9% (n=188) and limb 19.2% (n=158) (Table 12). With regards to sublocation, 60 of 176 tumors, with a sublocation on the head, were described by the referring veterinarian as located on the jaw (34.1%), 42 were described as on the ear (23.9%) and 22 were described as on the lip (12.5%). The upper arm was the most common location on the limb with 54 (39.1%) of 138, followed by the Toe/Foot pads with 27 (19.6%) of 138 and the shoulder with 21 (15.2%) out of 138.

(adeno)Carcinoma was the most commonly diagnosed neoplasia in the Siamese cat 37.8% (n=28), followed by "Other breeds" 37.0% (n=64) and the Persian cat 32.5% (n=25) (Table 10). Siamese cats were 2.06 times (p<0.001) more likely to be diagnosed with an (adeno)carcinoma (based on 8,431 cats) compared to all other cats. The Siamese (P=0.0003, OR = 2.42 [CI 1.50; 3.90]), Persian cat (P=0.009, OR = 1.91 [CI 1.18; 3.10]) and "Other breeds" (P=<0.0001, OR = 2.33 [CI 1.69; 3.21]) had statistically significant increased odds of having (adeno)carcinoma compared to the non-pedigree population (Table 20).

(adeno)Carcinoma was both in the European Shorthair 67.1% (169/of 252) and pure-breed cats 69.5% (73/105), most commonly diagnosed in the mammary gland (Table 14). Cats were 4.05 times more likely to develop an (adeno)carcinoma in the mammary gland (p<0.001), than in any other location, based on 3820 cats. Cats were 7.69 times more likely to develop an (adeno)carcinoma in the mammary gland (p<0.001), than any other neoplasia, based on 3820 cats. In the European Shorthair, the perineal area 55.9% (19/34) was also a common location, while in pedigree cats the abdominal wall 28.6% (10/35) and head 21.2% (31/146) were common locations (Table 14).

The mammary gland was the most common location for an (adeno)carcinoma in the Siamese cat 90.5% (19/21), Persian cat 80.0% (12/15), British Shorthair 75.0% (9/12) and the Maine Coon 47.1% (8/17) (Tables 15,16,17). The head was the most common location for an (adeno)carcinoma in the British Shorthair 31.8% (7/22) and the limb in the Persian cat 44.4% (4/9) (Tables 16,17).

(adeno)Carcinoma was the most commonly diagnosed neoplasia at the age between 5-10 years in the mammary gland 59.4% (38/64), at age 10-<15 in the mammary gland 79.2% (133/168) and perineum 57.9% (11/19), at age 15-<20 in the mammary gland 91.7% (55/60), the perineum 64.3% (9/14), the abdominal wall 30.0% (18/60) and the neck 25.0% (22/88) (Tables 18,19).

Mesenchymal proliferation, suspect sarcoma

The "mesenchymal proliferation, suspect sarcoma" (809 cases) was the second most common diagnosis and was diagnosed in 21.2% of all cats. There were 407 male and 376 female cats with this specific diagnosis. The mean age at diagnosis of "mesenchymal proliferation, suspect sarcoma" was 11.77 ± 3.93 years and the median age was 12.06 years (Table 11). The limb was the most common location 50.6% (n=409), followed by the head 12.1% (n=98) (Table 12). With regards to sublocation 145 of 341 tumors, on the limb, were described by the referring veterinarian as located on the shoulder (42.5%), 39 were described as on the upper arm/elbow/axilla (11.4%) and 34 were described as on the upper leg (10.0%). The jaw was the most common location on the head with 28 (33.3%) of 84, followed by the eye with 14 (16.7%) of 84 and the ear with 14 (16.7%) of 84.

The "mesenchymal proliferation, suspect sarcoma" was the most commonly diagnosed neoplasia in the European Shorthair 22.7% (n=741), followed by the Norwegian Forest cat 20.5% (n=8) and the British

Shorthair 17.1% (n=14) (Table 10). The European Shorthair was 1.91 times (p<0.001) more likely to be diagnosed with an "mesenchymal proliferation, suspect sarcoma" (based on 8,431 cats) compared to pure breed cats. The Siamese cat (P=0.0015, OR = 0.20 [CI 0.07; 0.54]), Persian cat (P=0.0135, OR = 0.40 [CI 0.19; 0.83]), and "Other breeds" (P=<0.001, OR = 0.35 [CI 0.21; 0.59]) had statistically significant decreased odds of having "mesenchymal proliferation, suspect sarcoma' compared to the non-pedigree population (Table 22).

Based on the anatomical location, the diagnosis "mesenchymal proliferation, suspect sarcoma" was in the European Shorthair, most commonly found on the limb 39.0% (382/979), back 35.1% (33/94), thoracic wall 35.0% (72/206) and abdominal wall 27.4% (64/234), while in pedigree breeds, it was most commonly found on the back 25.0% (5/20), the limb 22.7% (27/119) and the thoracic wall 18.2% (6/33) (Table 14).

The limb was the most common location for a "mesenchymal proliferation, suspect sarcoma" in the British Shorthair 31.8% (7/22), Maine Coon 26.1% (6/23) and Siamese cat 18.8% (3/16) (Tables 15,16). Cats were 2.54 times (p<0.001) more likely to be diagnosed with a "mesenchymal proliferation, suspect sarcoma" on the limb (based on 3,820 cats) than in any other location. Cats were 2,21 times (p<0.001) more likely to be diagnosed with a "mesenchymal proliferation, suspect sarcoma" on the limb, than any other neoplasia on this location.

"Mesenchymal proliferation, suspect sarcoma" were most commonly diagnosed at the age 0-<5 on the limb 40.0% (22/55) and the neck 28.0% (6/21), at age 5-<10 on the back 38.7% (12/31), limb 36.6% (90/246), thoracic wall 33.3% (18/54) and abdominal wall 25.5% (14/55), at age 10-<15 on the limb 35.3% (185/524), on the back 32.0% (16/50), the thoracic wall 29.6% (32/108), the abdominal wall 27.6% (35/127) and the tail 25.9% (7/27) and at age 15-<20 on the limb 43.0% (98/228), on the thoracic wall 38.8% (19/49) and the back 28.0% (7/25) (Tables 18,19).

Squamous cell carcinoma

The squamous cell carcinoma (460 cases) was the third most common neoplasm and was diagnosed in 12.0% of all cats. There were 212 male and 230 female cats with this specific diagnosis. The mean age at diagnosis of a squamous cell carcinoma was 13.63 ± 3.19 years and the median age was 13.88 (Table 11). The head was the most common location 81.3% (n=374). (Table 12). Cats were 10.55 times (p<0.001) more likely to be diagnosed with a squamous cell carcinoma on the head (based on 3,820 cats) than in any other location. Cats were 3.69 times (p<0.001) more likely to be diagnosed with a squamous cell carcinoma on the head (based on 3,820 cats), than any other neoplasia on this location. With regards of sublocation 203 of 367 tumors, with a sublocation on the head, were described by the referring veterinarian as located on the jaw (55.3%), 52 were described as located on the ear (14.2%) and 44 were described as located on the cheek (12.0%).

Squamous cell carcinoma was (based on percentage) most commonly diagnosed in the Persian cat 16.9% (n=13), followed by the European Shorthair 13.1% (n=428) and the Maine Coon 5.5% (n=6) (Table 10). The Siamese (P=0.0186, OR = 0.18 [CI 0.05; 0.75]), British Shorthair (P=0.0195, OR = 0.25 [CI 0.08; 0.80]), Maine Coon (P=0.0246, OR = 0.39 [CI 0.17; 0.89]) and other breeds (P=<0.001, OR = 0.24 [CI 0.11; 0.54]) had statistically significant decreased odds of having squamous cell carcinoma compared to the non-pedigree population (Table 21).

Squamous cell carcinoma occurrence between the European Shorthair and the pedigree breeds could be determined. The squamous cell carcinoma was in the European Shorthair 36.0% (349/969) and Persian cat 40.7% (11/27), most commonly found at the head (Tables 14, 17).

Squamous cell carcinoma located on the head, were most common at the age 5-<10 17.9% (32/179), 10-<15 33.6% (190/566) and 15-<20 44.5% (130/292) (Tables 18,19).

Benign epithelial proliferation

Benign epithelial proliferation (370 cases) was the fourth most common neoplasm, present

in 9.7% of all cats. There were 138 male and 220 female cats with this specific diagnosis (Table 11). Benign epithelial proliferation was significantly more likely in female cats (RR = 1.57, p<0.001) than in male cats, based on 8,135 cats. The mean age at diagnosis was 10.05 ± 5.16 years and the median age was 11.08 (Table 11). The head was the most common location 25.4% (n=94), followed by mammary gland 22.4% (n=83) and limb 14.9% (n=55) (Table 12). With regards to sublocation 25 of 82 tumors, with a sublocation on the head, were described by the referring veterinarian as located on the ear (30.5%), 15 were described as located on the eye (18.3%), 15 were located on the lip (18.3%) and 10 were located on the nose (12.2%). The shoulder was the most common location on the limb with 13 (29.5%) of 44, followed by the upper arm/elbow/axilla with 8 (18.2%) of 44, 6 were located on the toe and on the heel (13.6%).

A "benign epithelial proliferation" was the most commonly diagnosed neoplasia in the Norwegian Forest cat 25.6% (n=10), followed by the Maine Coon 21.2% (n=23) and Persian cat 13.0% (n=10) (Table 10). Norwegian Forest cats were 2.66 times (P=0.001) more likely to be diagnosed with a benign epithelial proliferation (based on 8,431 cats) compared to all other cats. The Maine Coon (P=<0.0001, OR = 2.71 [CI 1.69; 4.37]) and Norwegian Forest cat (P=0.0008, OR = 3.50 [CI 1.69; 7.25]) had statistically significant increased odds of having a benign epithelial proliferation compared to the non-pedigree population (Table 23).

In the European Shorthair the diagnosis, "benign epithelial proliferation" was most commonly reported on the tail 26.9% (n=14 out of 52), while in pedigree breeds, it was most commonly reported on the thoracic wall 18.2% (6/33) (Table 14).

The limb was the most common location for a benign epithelial proliferation in the Siamese cat 18.8% (3/16) (Table 15). The mammary gland was most commonly affected in the Maine Coon 47.1% (8/17) (Table 16).

The benign epithelial proliferation was the most commonly diagnosed neoplasia at the age between 0-5 years in the mammary gland 81.3% (39/48) and on the thoracic wall 35.0% (7/20). At the age between 5-10 years, the tumor was most common found on the tail 44.4% (4/9) (Table 18).

Lymphoma

Lymphoma (288 cases) was diagnosed in 7.5% of all cats. There were 169 males and 114 females with this specific diagnosis. The mean age at diagnosis of lymphoma was 11.41 ± 3.89 years and the median age was 11.56 year (Table 11). The head was the most common location 34.4% (n=99), followed by the neck 30.2% (n=87) and the limb 18.4% (n=53) (Table 12). With regards to sublocation 37 of 87 tumors, with a sublocation on the head, were described by the referring veterinarian as located in/on the nose (42.5%), 27 were described as on the jaw (31.0%) and 12 were located at the eye (13.8%).

Lymphoma was (based on percentage) most commonly diagnosed in the Siamese cat 18.9% (n=14), followed by the Maine Coon 13.8% (n=15) and the British Shorthair 11.0% (n=9) (Table 10). Siamese cats were 2.98 times (p<0.001) more likely to be diagnosed a lymphoma (based on 8,431 cats) compared to all other cats. The Siamese cat (P=0.0002, OR = 3.08 [CI 1.70; 5.60]) and Maine Coon (P=0.0093, OR = 2.11 [CI 1.20; 3.69]) had statistically significant increased odds of having Lymphoma compared to the non-pedigree population (Table 24).

Lymphoma was both in Domestic Shorthair 20.3% (68/335) and pure-breed cats 31.7% (19/60) most commonly diagnosed in the neck (Table 14).

The neck was the most common location for a lymphoma in the Maine Coon 50.0% (10/20) (Table 16). The head was the most common anatomical location for a lymphoma in Norwegian Forest cat 33.3% (3/9) and the Siamese cat 32.0% (8/25) (Table 15) and the limb in the Siamese cat 18.8% (3/16) (Table 15).

The Lymphoma was the most commonly diagnosed neoplasia at the age between 5-10 years in the neck 29.5% (23/78) and between the age 10-15 years in the neck 21.2% (40/189) (Tables 18,19).

(injection-site)Sarcoma

(injection-site)Sarcoma (256 cases) was diagnosed in 6.7% of all cats. There were 129 male and 112 female cats with this specific diagnosis. The mean age at diagnosis of an (injection-site)sarcoma was 11.55 ± 3.86 years and the median age was 11.95 years (Table 11). The limb was the most common location 51.2% (n=131), followed by the thoracic wall 12.5% (n=32) and the head 11.7% (n=30) (Table 12). Cats were 2.6 times (p<0.001) more likely to be diagnosed with an (injection-site)sarcoma on the limb (based on 3,820 cats) than in any other locations. Cats were 1.89 times (p<0.001) more likely to be diagnosed with an (injection-site)sarcoma on the limb (based on 3,820 cats), than any other neoplasia on this location. With regards to sublocation 67 of 117 tumors, with a sublocation on the limb, were described by the referring veterinarian as located on the shoulder (57.3%). The jaw was the most common location on the head with 9 of 22 tumors (40.9%).

(injection-site)Sarcoma was (based on percentage) most commonly diagnosed in the Norwegian Forest cat 12.8% (n=5) (Table 10).

In the European Shorthair, (injection-site)sarcoma had no predilection site, but in pedigree breeds, this neoplasia was most commonly found on the back 25.0% (n=5 out of 20) (Table 14).

Mast cell tumor

The mast cell tumor (251 cases) was diagnosed in 6.6% of all cats. There were 135 male and 107 female cats with this specific diagnosis. The mean age at diagnosis of a mast cell tumor was 11.47 ± 4.22 years and the median age was 11.64 year (Table 11). The head was the most common location 39.8% (n=100), followed by the limb 26.7% (n=67) (Table 12). With regards of sublocation 33 of 86 tumors, with a sublocation head, were described by the referring veterinarian as located in the region of the eye (38.4%), 31 near the ear (36.0%) and 9 on the cheek (10.5%). Cats were 1.61 times (p<0.001) more likely to be diagnosed with a mast cell tumor on the head (based on 3,820 cats) than in any other location. Cats were 1.40 times (p<0.001) more likely to be diagnosed with a mast cell tumor on the head (based on 3,820 cats) than any other neoplasia on this location. The upper arm was the most common location on the limb with 14 of 47 tumors (29.8%), followed by the shoulder (n=9; 19.1%).

The mast cell tumor was (based on percentage) most commonly diagnosed in the Siamese cat 16.2% (n=12), followed by the Maine Coon (n=12), British Shorthair (n=9) and the "Other breeds" (n=19) 11.0%. (Table 10). The Siamese cat (P=0.0005, OR = 3.10 [CI 1.64; 5.85]), British Shorthair (P=0.0596, OR = 1.97 [CI 0.97; 4.01]), Maine Coon (P=0.030, OR = 1.98 [CI 1.07; 3.67]) and other breeds (P=0.0074, OR = 1.98 [CI 1.20; 3.25]) had statistically significant increased odds of having mast cell tumor compared to the non-pedigree population (Table 26).

In the European Shorthair mast cell tumors showed no predilection site, but in Maine Coon, it was most commonly found on the head 25.9% (7/27) (Tables 14,16).

The mast cell tumor was the most commonly diagnosed neoplasia at the age between 0-5 years on the head 25.0% (8/32) and at the age between 15-20 years on the tail 31.3% (5/16) (Tables 18,19).

Mesenchymal proliferation, suspect Inflammation

The "mesenchymal proliferation, suspect inflammation" (148 cases) was present in 3.9% of all cats. There are 80 male and 65 female cats with this specific diagnosis. The mean age at diagnosis of an "mesenchymal proliferation, suspect inflammation" was 11.36 ± 3.93 years and the median age was 11.55 year (Table 11). The limb was the most common location 40.5% (n=60), followed by the head 16.2% (n=24) and the abdominal wall 12.2% (n=18) (Table 12). With regards to sublocation 28 of 52 tumors, with a sublocation on the limb, were described by the referring veterinarian as located near the shoulder (53.8%). Cats were 1.69 times (p=0.001) more likely to be diagnosed with a mesenchymal proliferation, suspect inflammation on the limb (based on 3,820 cats) than in any other location. Cats were 1.43 times (p=0.001) more likely to be diagnosed with a mesenchymal proliferation, suspect inflammation on the limb (based on 3,820 cats) than any other neoplasia on this

location. The ear was the most common location on the head with 8 of 24 tumors (33.3%).

The "mesenchymal proliferation, suspect inflammation" was (based on percentage) most commonly diagnosed in the Norwegian Forest cat 5.1% (n=2) (Table 10).

Melanocytic proliferation

The melanocytic proliferation (99 cases) was present in 2.6% of all cats. There were 41 male and 58 female cats with this specific diagnosis. The mean age at diagnosis of a melanocytic proliferation was 12.83 ± 3.48 years and the median age was 12.98 year (Table 11). The head was the most common location 54.5% (n=54), followed by the limb 15.2% (n=15) and the neck 12.1% (n=12) (Table 12). Cats were 2.91 times (p<0.001) more likely to be diagnosed with a melanocytic proliferation on the head (based on 3,820 cats) than in any other location. Cats were 1.91 times (p<0.001) more likely to be diagnosed with a melanocytic proliferation on the head (based on 3,820 cats) than any other neoplasia on this location. With regards to sublocation 15 of 51 tumors, with a sublocation on the head, were described by the referring veterinarian as located at the ear (29.4%), 11 on the eye (21.6%) and 9 on the jaw (17.6%). The upper leg was the most common location on the limb with 3 of 9 tumors (33.3%).

The melanocytic proliferation was (based on percentage) most commonly diagnosed in the Persian cat 3.9% (n=3). (Table 10).

Lipoma

Lipoma (84 cases) was present in 2.2% of all cats. There were 46 male and 34 female cats with this specific diagnosis. The mean age at diagnosis of a lipoma was 10.66 ± 3.98 years and the median age was 11.53 year (Table 11). The limb was the most common location 34.5% (n=29), followed by the abdominal wall 23.8% (n=20) and the thoracic wall 19.0% (n=16) (Table 12). With regards to sublocation 10 of 28 tumors, with a sublocation on the limb, were described by the referring veterinarian as located at the shoulder (35.7%), 8 were described as on the upper leg (28.6%) and 5 were described as on the upper arm (17.9%).

The lipoma was (based on percentage) most commonly diagnosed in the "Other breeds" 6.9% (n=12). (Table 10). The "Other breeds" (P=0.0001, OR = 3.61 [CI 1.92; 6.82]) had statistically significant increased odds of having a lipoma compared to the non-pedigree population (Table 31).

Suspect Lymphoma

Suspect lymphoma was the diagnosis in 79 cases accounting for 2.1% of all cats. There were 45 male and 30 female cats with this specific diagnosis. The mean age at diagnosis of suspect lymphoma was 11.39 ± 3.92 years and the median age was 11.97 year (Table 11). The neck was the most common location 40.5% (n=32), followed by the head 26.6% (n=21) and the limb 20.3% (n=16) (Table 12). Cats were 5.9 times (p<0.001) more likely to be diagnosed with a suspect lymphoma on the neck (based on 3,820 cats) than in any other locations. Cats were 4.17 times (p<0.001) more likely to be diagnosed with suspect lymphoma on the neck (based on 3,820 cats) than any other neoplasia on this location. With regards to sublocation 7 of 20 tumors, with a sublocation on the head, were described by the referring veterinarian as located at/near the jaw (35.0%) and 6 on the nose (30.0%). The shoulder was the most common location on the limb with 6 of 14 tumors (42.9%).

The suspect lymphoma was (based on percentage) most commonly diagnosed in the Siamese cat 4.1% (n=3). (Table 10).

Other/undefined diagnoses

The category undefined diagnoses contained the diagnoses that were not classified in the other tumor groups or that could not be defined, based on the cytology report (anaplastic malignant tumors). The "undefined diagnoses" (155 cases) made up 4.1% of all cats. There are 85 male and 68 female cats with this diagnosis. The mean age at diagnosis of the undefined diagnoses was 12.14 ± 3.59 years and the median age was 11.53 year (Table 11). The limb was the most common location 43.2% (n=67), followed by the head 21.3% (n=33) and the neck 16.8% (n=26)

(Table 12). With regards to sublocation 17 of 50 tumors, with a sublocation on the limb, were described by the referring veterinarian as located at the hock (tarsus) (34.0%). The jaw was the most common location on the head with 8 of 30 tumors (26.7%), followed by the ear with 7 of 30 tumors (23.3%).

The undefined diagnoses were (based on percentage) most commonly diagnosed in the European Shorthair 4.2% (n=138). (Table 10).

Discussion

Although histopathology is the gold standard for diagnosing and characterizing neoplasia, however cytology shows an excellent correlation with the histology of (sub)cutaneous neoplasia [7]. The goals of this study were to review the cytological diagnoses of (sub)cutaneous neoplasia in the cat. For this purpose, the authors retrospectively analyzed the cytology results from a cohort of cats submitted to a single commercial veterinary laboratory and compared these cytology results to previously published histopathological studies.

Because of the several different diagnoses found in two studies, some data were difficult to compare. In the UK study, the most common diagnosis was basal cell tumor 27%. In this study the basal cell tumor is classified under the category benign epithelial proliferations, which is fourth in place with 11%. Apocrine cystadenoma and basal cell tumors (from the UK study) are classified, in this study under the category benign epithelial proliferation, which also contains the diagnosis FAH. Therefore, it is impossible to compare these categories. Fibrosarcoma (22% in UK study) is in this study classified under the category sarcoma which is 35% and contains the subcategories (injection-site)sarcoma, suspect sarcoma and suspect inflammation. In this study, sarcoma is the most common diagnosis and can be compared with the fibrosarcoma and haemangiosarcoma from the UK study. These two groups together, in the UK study, account for 27% compared to the previously mentioned 35% in this study. The squamous cell carcinoma account for 13% in both studies (UK and this study) and is third in place. The mast cell tumor account for 8% in the UK study and for 7% in this study. The lipoma account for 7% in the UK study and just 2% in this study and could not be compared. In this study, it was difficult to compare the cyst with the UK study. The cysts were removed of the group of neoplasia and categorized as a tumor (n=8431). The group of carcinomas consisted in the UK study, of a smaller percentage (8.61%) than this study (23.34%). The carcinomas in the UK study consists of the undifferentiated carcinoma, basal cell carcinoma and the ceruminous gland tumor (Table 13, Figures 5,6).

The differentiation between epithelial, mesenchymal, haematopoietic, melanocytic and other neoplasia could be compared between the two studies. The UK study consisted of a higher percentage of epithelial (UK=51.98%, this study=43.22%), mesenchymal (UK=34.17%, this study=33.95%) and other neoplasia (UK=4.21%, this study=4.06). This study contained a higher percentage of haematopoietic (UK=7.76%, this study=16.18%) and melanocytic neoplasia (UK=1.87%, this study=2.59%) (Figures 3,4). This could be due to the different techniques used.

There were 19,161 feline cytology cases, of which 44.0% (8,431) were (sub)cutaneous masses. Of these (sub)cutaneous masses, 45.31% (3,820) were (sub)cutaneous neoplasia. The (sub)cutaneous neoplasia compromised for 19.94% of the total feline cytology cases. Twelve types of neoplasm categories were diagnosed, including one category that contained all “Other neoplasms”. Four types of tumors accounted for 64.4% of all feline skin tumors. These four tumors, in order of frequency in the study, were (Adeno) carcinoma, “Mesenchymal proliferation, suspect sarcoma”, Squamous cell carcinoma and Benign epithelial proliferation. The benign epithelial proliferation (mean age = 10.05 ± 5.16, median age = 11.08) is more likely at a younger age than the other tumors and the squamous cell carcinoma (mean age = 13.63 ± 3.19, median age = 13.88) is more likely at an older age compared to the other tumors.

The most common breed of the 36 breeds containing a (sub)cutaneous neoplasia (n=3820), was the European Shorthair (85.5%). The 5 most common pure-breeds and the European Shorthair accounted for 95.5% of the cats available. The remainder (4.5%) were 30 cats, which were included in the category "other breeds". The European Shorthair had the oldest mean of 12.30 ± 3.83 years old and the Maine Coon had the youngest mean of 9.17 ± 4.37 years old. This suggests that for different breeds, it is more common to get tumors at a different age.

Despite that cytology is quicker, easier, less invasive and superior for certain diagnoses (especially in the group of round cell tumors, including mast cell tumors, lymphoma and melanocytic proliferation), histopathology should be performed besides cytology to obtain the exact diagnosis. The numbers of round cell tumors were also less than the number of the four most common tumors, which were epithelial and mesenchymal tumors (Table 11). The population of the study consisted of all feline submissions of cytology to the UVDL. Unfortunately, there was a possibility that a veterinarian located a mass by him/herself and diagnosed it, without sending it to the UVDL. Therefore, there was a possibility that some data were missing in this study. It was uncertain if there were other diagnostic methods used to clarify the diagnosis, other than methods of cytology.

During the study some difficulties were encountered. Diagnoses were sometimes difficult to interpret, because of the lack of information and because of the lack of a clear diagnosis. Sometimes the vet/cytologist on duty was uncertain of the actual diagnosis or suggested a diagnosis. The location was also difficult to interpret, because of the lack of information or because of many uncertainties. It was sometimes uncertain if the mass was (sub)cutaneous or deeper in the body of the cat, so all the masses palpable on the surface of the cats were included in the study. There were also locations described as "skin" and "region of", which made it difficult to interpret a certain description to a location. Some tumors, like lymphomas in the neck, might be tumors originating from the regional lymph nodes, rather than the skin, but this was in most cases an assumption due to the lack of information. The location upper arm was also doubtful, because of the transition of the leg and the mammary gland (towards the axilla) or the neck. There is a chance that some diagnosed locations on the leg were actually on the mammary gland. The tumors on the mamma could represent tumors of the mammary gland, but also tumors of the skin overlying the mammary glands. The submissions of the vet for cytology, needs to be more specific on the anatomical location of the tumor/neoplasia send to the UVDL, because the exact location is sometimes uncertain.

There could be an overlap of the categories "mesenchymal proliferation, suspect sarcoma", (injection-site)sarcoma and "mesenchymal proliferation, suspect inflammation". "Mesenchymal proliferation, suspect inflammation" could be just an inflammation, but because of this uncertainty, this category was included in this study in the group neoplasia. The category "other tumors" included a mix of tumors, which could not be divided in the other groups of malign or benign tumors. This category contained both malignant and benign tumor variants and tumors, which were infrequently diagnosed in this study. Finally, there were data missing, leading to unrealistic ages of over 100 and of 0,0. These data were removed from the file and less data was available.

This study 2018	N	%	UK study 2018	N	%
Sarcoma (Suspect sarcoma, injection-site sarcoma, suspect inflammation,	1213	34.48	**Fibrosarcoma**	1766	22.0
			Haemangiosarcoma	404	5.0
(adeno)Carcinoma	821	23.34	**Carcinoma, undifferentiated**	255	3.2
			Basal cell carcinoma	252	3.1
			Ceruminous gland tumour	183	2.3
Squamous cell carcinoma	460	13.08	**Squamous cell carcinoma**	1031	12.9
Benign epithelial proliferation	370	10.52	**Basal cell tumour**	2189	27.3
			Apocrine cystadenoma	269	3.4
Cyst	319	9.07	**Follicular cysts**	307	3.8
			Apocrine gland cysts	178	2.2
			Dermoid cysts	44	0.5
Mast cell tumor	251	7.13	**Mast cel tumour**	618	7.7
Lipoma	84	2.39	**Lipoma**	516	6.4

Table 13: Comparison of the neoplasms of this study and the UK study.

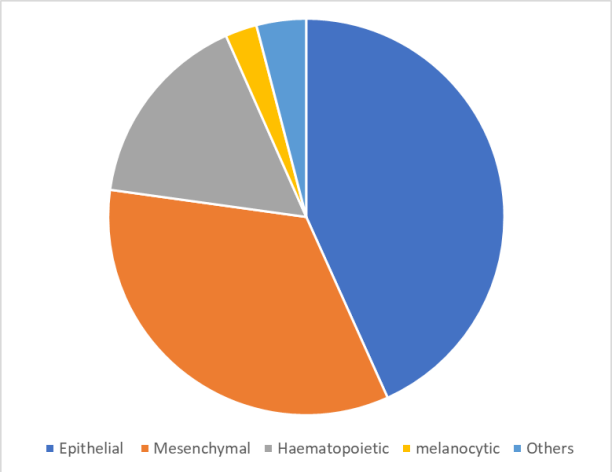


Figure 3: Distribution of this study: epithelial, mesenchymal, haematopoietic, melanocytic and other neoplasms.

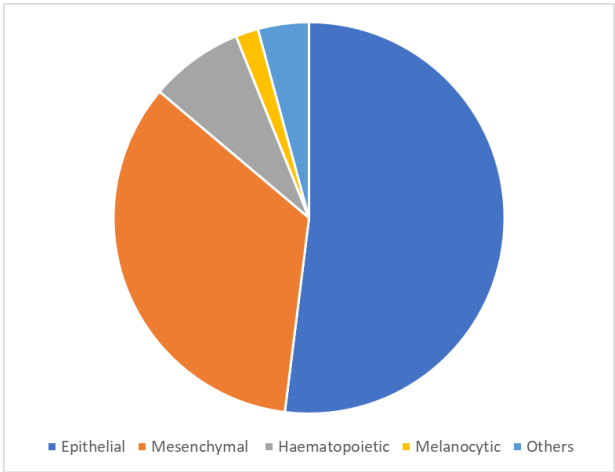


Figure 4: Distribution of UK study: epithelial, mesenchymal, haematopoietic, melanocytic and other neoplasms.

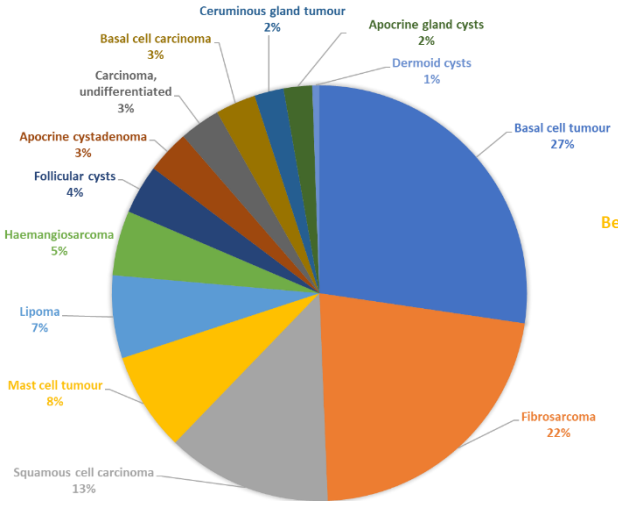
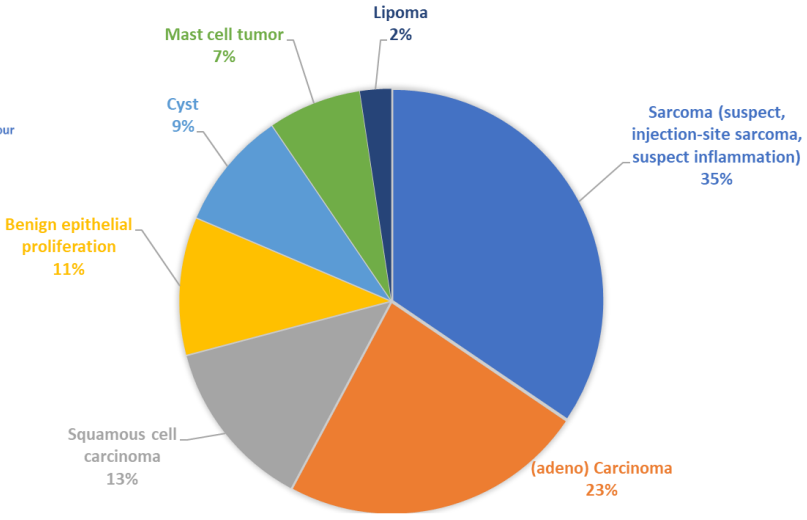


Figure 5: Percentages of the neoplasms of the UK study



and Figure 6: Percentages of the neoplasms of this study

Conclusion

In this study, some tumors/neoplasia were significant more likely at/in a location, gender or breed. The (adeno)carcinoma and benign epithelial proliferation were significant more likely in the female cat. The (adeno)carcinoma was also significant more likely on the mammary gland and on the Siamese cat, Persian cat and "Other breeds". The benign epithelial proliferation was also significant more likely on the Norwegian Forest cat and the Maine Coon. The "mesenchymal proliferation, suspect sarcoma", (injection-site)sarcoma and "mesenchymal proliferation, suspect inflammation" were significant more likely on the limb. The squamous cell carcinoma, mast cell tumor and melanocytic proliferation were significant more likely on the head. The mast cell tumor was also significantly more likely on the Siamese cat, British Shorthair, Maine Coon and "Other breeds". The lymphoma was significantly more likely in the Siamese Cat and the Maine Coon. The suspect lymphoma were more likely to be found on the neck. The "Other breeds" were significantly more likely to be diagnosed with a lipoma.

(adeno)Carcinoma most common on the mammary gland in female cats, and in the Siamese cat. Mesenchymal proliferations categories are possibly the same diagnosis according to the outcome of almost the same mean age, division of male/female cats, most common breeds and location. Lymphoma and suspect lymphoma are possibly the same categories according to the outcome of almost the same mean age, division of male/female cats, most common breeds and location. Mesenchymal proliferations were most common on the shoulder, which is the place for an injection-site sarcoma. Benign epithelial proliferation has the youngest mean, which means it is more likely to be diagnosed at a younger age, in Norwegian Forest cats. Squamous cell carcinoma was most common on the head, with a high percentage and a high relative risk. Lymphoma and suspect lymphoma were common on the neck and head, which can also be lymph nodes.

This study could be a start-up for studies based on cytological databases in the future and in general of neoplasm distributions in the cat in the Netherlands. The golden standard is histopathology for specifying the neoplasms [7]. So, in the future, there has to be a study based on the databases of histopathology in the Netherlands. The results obtained from the histopathological study can be compared with the results obtained from this cytological study, for more complete data of the distributions of feline (sub)cutaneous neoplasia.

Some data of this study can be used in the clinic. The predilections retrieved in this study can help the clinician to make a faster diagnosis and could help him/her to create the DDx (differential diagnosis).

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Attachment

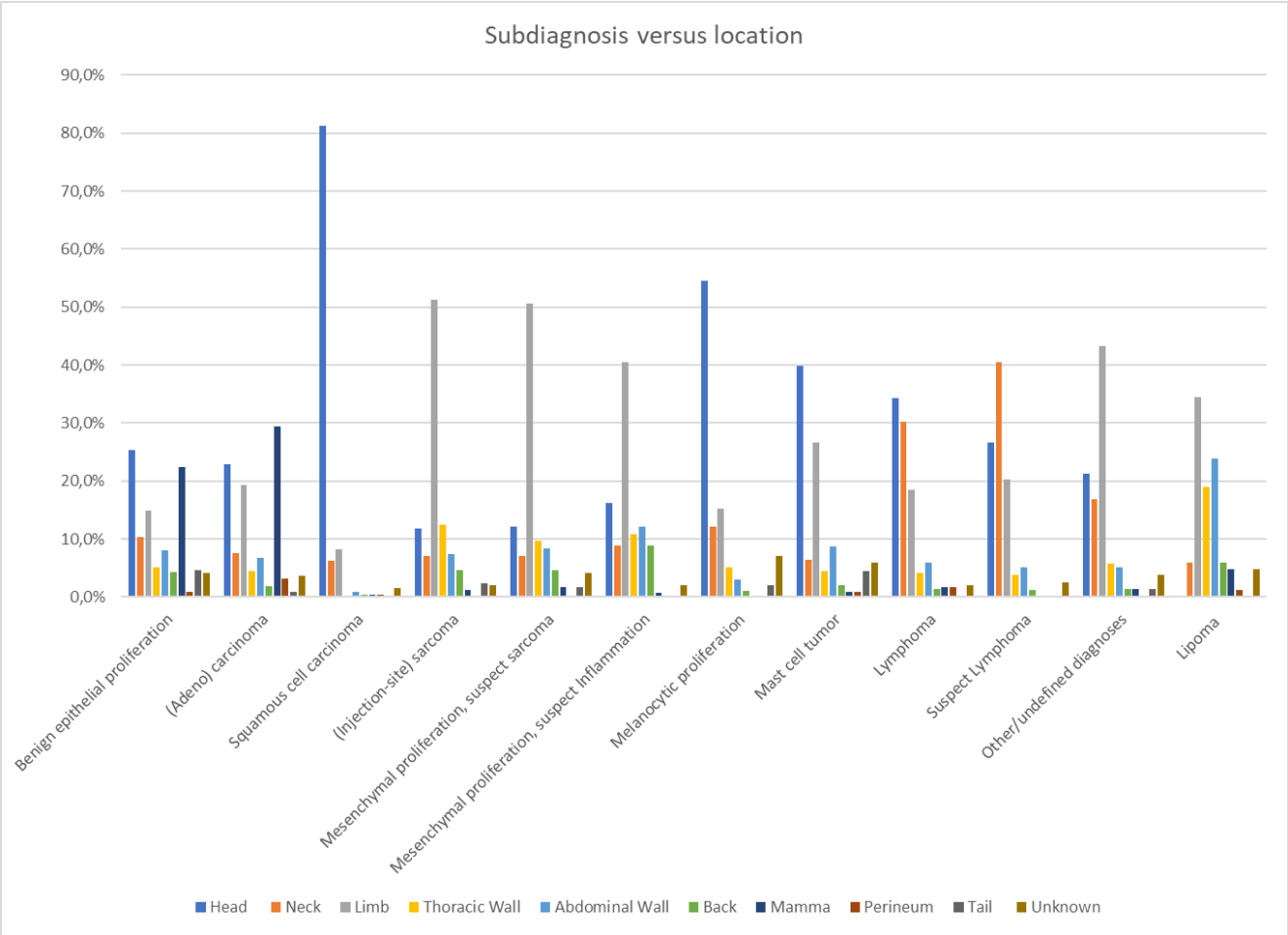

Figure 7: bar graph of the distribution of the location (%) of the different sub-diagnoses.

	European Shorthair	%	Pedigree Breeds	%
Head	**N** = 969		**N** = 146	
	1: Squamous cell carcinoma	36.0	**1:** (Adeno)carcinoma	21.2
	2: (Adeno)carcinoma	16.2	**2:** Mast cell tumor	20.5
	3: Suspect sarcoma	9.0	**3:** Squamous cell carcinoma	17,1
Neck	**N** = 335		**N** = 60	
	1: Lymphoma	20.3	**1:** Lymphoma	31.7
	2: (Adeno)carcinoma	16.1	**2a:** (Adeno)carcinoma **2b:** Suspect sarcoma	13.3
	3: Suspect sarcoma	14.6	**3:** Suspect lymphoma	11.7
Limb	**N** = 979		**N** = 119	
	1: Suspect sarcoma	39.0	**1:** Suspect sarcoma	22.7
	2: (Adeno)carcinoma	13.9	**2:** (Adeno)carcinoma	18.5
	3: (Injection-site)sarcoma	12.6	**3:** Benign epithelial proliferation	14.3
Thoracic wall	**N** = 206		**N** = 33	
	1: Suspect sarcoma	35.0	**1a:** Benign epithelial proliferation **1b:** Suspect sarcoma	18.2
	2: (Adeno)carcinoma	15.5	**2a:** (Adeno)carcinoma **2b:** Lipoma	15.2
	3: (injection-site)Sarcoma	14.1	**3a:** (injection-site)Sarcoma **3b:** Lymphoma	9.1
Abdominal wall	**N** = 234		**N** = 35	
	1: Suspect sarcoma	27.4	**1:** (Adeno)carcinoma	28.6
	2: (Adeno)carcinoma	19.7	**2a:** Benign epithelial proliferation **2b:** Suspect sarcoma **3c:** Mast cell tumor	11.4
	3: Benign epithelial proliferation	11.1	**3a:** (injection-site)Sarcoma **3b:** Lipoma	8.6
Back	**N** = 94		**N** = 20	
	1: Suspect sarcoma	35.1	**1a:** (Injection-site)Sarcoma **1b:** Suspect sarcoma	25.0
	2: Benign epithelial proliferation	16.0	**2a:** (Adeno)carcinoma **2b:** Mast cell tumor	15.0
	3: Suspect Inflammation	13.8	**3:** Lymphoma	10.0
Mammary gland	**N** = 252		**N** = 105	
	1: (Adeno)carcinoma	67.1	**1:** (Adeno)carcinoma	69.5
	2: Benign epithelial proliferation	22.2	**2:** Benign epithelial proliferation	25.7
	3: Suspect sarcoma	3.6	**3:** Suspect sarcoma	3.8
Perineum	**N** = 34		**N** = 7	
	1: (Adeno)carcinoma	55.9	**1:** (Adeno)carcinoma	100.0
	2: Lymphoma	14.7		
	3: Benign epithelial proliferation	8.8		
Tail	**N** = 52		**N** = 7	
	1: Benign epithelial proliferation	26.9	**1:** Mast cell tumor	57.1
	2: Suspect sarcoma	25.0	**2:** Benign epithelial proliferation	42.9
	3a: (Adeno)carcinoma **3b:** Mast cell tumor	13.5		

Table 14: The anatomical location of the European Shorthair was plotted against the anatomical location of the pedigree breeds. The percentage of the three most common diagnoses, of each category combination, were calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

	Siamese cat	%	Norwegian Forest cat	%
Head	**N** = 25		**N** = 9	
	1: Lymphoma	32.0	**1:** Lymphoma	33.3
	2: Mast cell tumor	28.0	**2:** Squamous cell carcinoma	22.2
	3: (Adeno)carcinoma	24.0	**3a:** Benign epithelial proliferation **3b:** (Adeno)carcinoma **3c:** Suspect sarcoma **3d:** Melanocytic proliferation	11.1
Neck	**N** = 8		**N** = 3	
	1a: Lymphoma **1b:** Suspect lymphoma	25.0	**1a:** Benign epithelial proliferation **1b:** (injection-site)Sarcoma **1c:** Suspect sarcoma	33.3
	2a: (Adeno)carcinoma **2b:** Squamous cell carcinoma **2c:** (injection-site)Sarcoma **2d:** Mast cell tumor	12.5		
Limb	**N** = 16		**N** = 8	
	1a: Benign epithelial proliferation **1b:** Suspect sarcoma **1c:** Lymphoma	18.8	**1a:** Benign epithelial proliferation; **1b:** (injection-site)Sarcoma **1c:** Suspect sarcoma **1d:** Suspect Inflammation	25.0
	2a: (Adeno)carcinoma **2b:** Mast cell tumor **2c:** Other/undefined diagnoses	12.5		
	3a: Lipoma	6.3		
Thoracic wall	**N** = 0		**N** = 3	
			1a: lipoma **1b:** Suspect sarcoma **1c:** Mast cell tumor	33.3
Abdominal wall	**N** = 2		**N** = 3	
	1a: Lymphoma **1b:** Other/undefined diagnoses	50.0	**1a:** Benign epithelial proliferation **1b:** (Adeno)carcinoma **1c:** Suspect sarcoma	33.3
Back	**N** = 1		**N** = 2	
	1: Mast cell tumor	100.0	**1:** (injection-site)Sarcoma	100.0
Mammary gland	**N** = 21		**N** = 8	
	1: (Adeno)carcinoma	90.5	**1:** Benign epithelial proliferation	62.5
	2: Benign epithelial proliferation	9.5	**2:** (Adeno)carcinoma	25.0
			3: Suspect sarcoma	12.5
Perineum	**N** = 0		**N** = 1	
			1: (Adeno)carcinoma	100.0
Tail	**N** = 1		**N** = 1	
	1: Mast cell tumor	100.0	**1:** Mast cell tumor	100.0

Table 15: To specify the likelihood of the different pedigree breeds, they were examined separately. The different breeds (Siamese cat and Norwegian Forest cat), were plotted against the anatomical location. The percentage of the three most common diagnoses, of each category combination, was calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

	Maine Coon	%	British Shorthair	%
Head	**N** = 27		**N** = 22	
	1: Mast cell tumor	25.9	**1:** (Adeno)carcinoma	31.8
	2a: (Adeno)carcinoma **2b:** Squamous cell carcinoma	18.5	**2a:** Benign epithelial proliferation **2b:** Squamous cell carcinoma **2c:** Mast cell tumor	13.6
	3a: Benign epithelial proliferation **3b:** Suspect sarcoma	11.1	**3a:** Suspect sarcoma **3b:** Lymphoma	9.1
Neck	**N** = 20		**N** = 8	
	1: Lymphoma	50.0	**1:** Lymphoma	37.5
	2a: Suspect sarcoma **2b:** Suspect lymphoma	15.0	**2:** (Adeno)carcinoma	25.0
	3a: Benign epithelial proliferation **3b:** (injection-site)Sarcoma **3c:** Suspect Inflammation **3d:** Others	5.0	**3a:** Suspect sarcoma **3b:** Melanocytic proliferation **3c:** Suspect lymphoma	12.5
Limb	**N** = 23		**N** = 22	
	1: Suspect sarcoma	26.1	**1:** Suspect sarcoma	31.8
	2: Benign epithelial proliferation	21.7	**2:** Benign epithelial proliferation	18.2
	3: (injection-site)Sarcoma	17.4	**3:** (Adeno)carcinoma	13.6
Thoracic wall	**N** = 8		**N** = 5	
	1: Benign epithelial proliferation	50.0	**1:** Benign epithelial proliferation	40.0
	2a: (Adeno)carcinoma **2b:** Suspect sarcoma **2c:** Melanocytic proliferation **2d:** Lymphoma	12.5	**2a:** (injection-site)Sarcoma **2b:** Suspect sarcoma **2c:** Others	20.0
Abdominal wall	**N** = 5		**N** = 7	
	1a: (Adeno)carcinoma **1b:** Suspect sarcoma	40.0	**1:** Lipoma	28.6
	2: Mastocytoma	20.0	**2a:** (Adeno)carcinoma **2b:** (injection-site)Sarcoma **2c:** Suspect sarcoma **2d:** Mast cell tumor **2e:** Lymphoma	14.3
Back	**N** = 1		**N** = 5	
	1: Suspect sarcoma	100.0	**1:** Mast cell tumor	40.0
			2a: (Adeno)carcinoma **2b:** Suspect sarcoma **2c:** Lymphoma	20.0
Mammary gland	**N** = 17		**N** = 12	
	1a: Benign epithelial proliferation **1b:** (Adeno)carcinoma	47.1	**1:** (Adeno)carcinoma	75.0
	2: Suspect sarcoma	5.9	**2a:** Benign epithelial proliferation **2b:** Suspect sarcoma **2c:** Lymphoma	8.3
Perineum	**N** = 0		**N** = 0	
Tail	**N** = 1		**N** = 1	
	1: Benign epithelial proliferation	100.0	**1:** Mast cell tumor	100.0

Table 16: To specify the likelihood of the different pedigree breeds, they were examined separately. The different breeds (Maine Coon and British Shorthair), were plotted against the anatomical location. The percentage of the three most common diagnoses, of each category combination, was calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

	Persian cat	%
Head	**N** = 27	
	1: Squamous cell carcinoma	40.7
	2: Benign epithelial proliferation	18.5
	3: (Adeno)carcinoma	11.1
Neck	**N** = 6	
	1: Lymphoma	33.3
	2a: (Adeno)carcinoma **2b:** Squamous cell carcinoma **2c:** Suspect sarcoma **2d:** Mast cell tumor	16.7
Limb	**N=** 9	
	1: (Adeno)carcinoma	44.4
	2: Suspect sarcoma	22.2
	3a: Suspect inflammation **3b:** Mast cell tumor **3c:** Others	11.1
Thoracic wall	**N** = 4	
	1: Suspect sarcoma	50.0
	2a: Lipoma **2b:** (injection-site)Sarcoma	25.0
Abdominal wall	**N** = 6	
	1a: Benign epithelial proliferation; **1b:** (Adeno)carcinoma; **1c:** Squamous cell carcinoma; **1d:** Suspect inflammation; **1e:** Mast cell tumor; **1f:** Others	16.7
Back	**N** = 4	
	1: (injection-site)Sarcoma	50.0
	2a: (Adeno)carcinoma **2b:** Suspect sarcoma	25.0
Mammary gland	**N** = 15	
	1: (Adeno)carcinoma	80.0
	2: Benign epithelial proliferation	20.0
Perineum	**N** = 2	
	1: (Adeno)carcinoma	100.0
Tail	**N** = 1	
	1: Benign epithelial proliferation	100.0

Table 17: To specify the likelihood of the different pedigree breeds, they were examined separately. The different breeds (Persian cat), were plotted against the anatomical location. The percentage of the three most common diagnoses, of each category combination, was calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

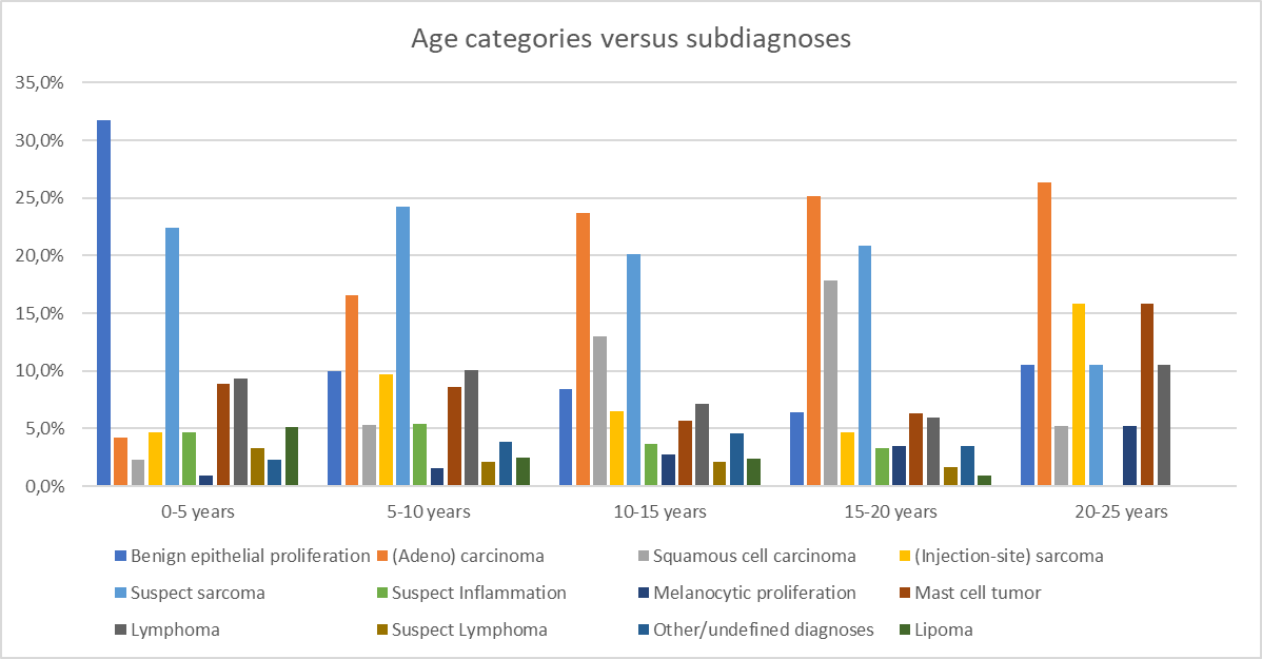

Figure 8: bar graph of the distribution of the sub-diagnoses (%) in the different age categories 0-<5, 5-<10, 10-<15 and 20-<25.

	0-<5 year	%	5-<10 year	%
Head	N = 32		N = 179	
	1: Mast cell tumor	25.0	**1:** Squamous cell carcinoma	17.9
	2: Benign epithelial proliferation	21.9	**2:** Mast cell tumor	16.2
	3: Lymphoma	15.6	**3:** (Adeno)carcinoma	13.4
Neck	N = 21		N = 78	
	1: Suspect sarcoma	28.6	**1:** Lymphoma	29.5
	2: Lymphoma	19.0	**2:** Suspect sarcoma	20.5
	3: Suspect lymphoma	14.3	**3a:** Benign epithelial proliferation **3b:** Mast cell tumor	9.0
Limb	N = 55		N = 246	
	1: Suspect sarcoma	40.0	**1:** Suspect sarcoma	36.6
	2: Mast cell tumor	14.5	**2:** (injection-site)Sarcoma	14.6
	3: Lymphoma	10.9	**3:** (Adeno)carcinoma	10.6
Thoracic wall	N = 20		N = 54	
	1: Benign epithelial proliferation	35.0	**1:** Suspect sarcoma	33.3
	2: Suspect sarcoma	25.0	**2:** (injection-site)Sarcoma	16.7
	3a: Lymphoma **3b:** Other/undefined diagnoses **3c:** lipoma	10.0	**3:** (Adeno)carcinoma	13.0
Abdominal wall	N = 23		N = 55	
	1: Benign epithelial proliferation	34.8	**1:** Suspect sarcoma	25.5
	2: Suspect sarcoma	26.1	**2:** Lymphoma	14.5
	3: Lipoma	13.0	**3a:** Benign epithelial proliferation **3b:** (Adeno)carcinoma	12.7
Back	N = 5		N = 31	
	1: Suspect sarcoma	60.0	**1:** Suspect sarcoma	38.7
	2a: (injection-site)Sarcoma **2b:** Suspect Inflammation	20.0	**2a:** Benign epithelial proliferation **2b:** (Adeno)carcinoma	16.1
			3: Lipoma	9.7
Mammary gland	N = 48		N = 64	
	1: Benign epithelial proliferation	81.3	**1:** (Adeno)carcinoma	59.4
	2: (Adeno)carcinoma	10.4	**2:** Benign epithelial proliferation	20.3
	3: Lymphoma	4.2	**3:** Suspect sarcoma	10.9
Perineum	N = 1		N = 7	
	1: (Adeno)carcinoma	100.0	**1:** (Adeno)carcinoma	71.4
			2a: Benign epithelial proliferation **2b:** Lymphoma	14.3
Tail	N = 4		N = 9	
	1a: Benign epithelial proliferation **1b:** Suspect sarcoma	50.0	**1:** Benign epithelial proliferation	44.4
			2: (injection-site)Sarcoma	22.2
			3a: (Adeno)carcinoma; **3b:** Suspect sarcoma; **3c:** Mast cell tumor	11.1

Table 18: The different age categories were plotted against the anatomical location. The age categories 0<-5 and 5-<10 were displayed in this table. The percentage of the three most common diagnoses, of each category combination, were calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

	10-<15 year	%	15-<20 year	%
Head	N = 566		N = 292	
	1: Squamous cell carcinoma	33.6	**1:** Squamous cell carcinoma	44.5
	2: (Adeno)carcinoma	17.5	**2:** (Adeno)carcinoma	19.5
	3: Lymphoma	8.7	**3:** Suspect sarcoma	8.6
Neck	N = 189		N = 88	
	1: Lymphoma	21.2	**1:** (Adeno)carcinoma	25.0
	2: (Adeno)carcinoma	16.4	**2:** Lymphoma	19.3
	3: Suspect sarcoma	12.2	**3:** Suspect sarcoma	10.2
Limb	N = 524		N = 228	
	1: Suspect sarcoma	35.3	**1:** Suspect sarcoma	43.0
	2: (Adeno)carcinoma	17.4	**2:** (Adeno)carcinoma	14.5
	3: (injection-site)Sarcoma	11.3	**3:** (injection-site)Sarcoma	10.1
Thoracic wall	N = 108		N = 49	
	1: Suspect sarcoma	29.6	**1:** Suspect sarcoma	38.8
	2: (Adeno)carcinoma	18.5	**2:** (Adeno)carcinoma	18.4
	3: (injection-site)Sarcoma	15.7	**3a:** Benign epithelial proliferation **3b:** Mast cell tumor	10.2
Abdominal wall	N = 127		N = 60	
	1: Suspect sarcoma	27.6	**1:** (Adeno)carcinoma	30.0
	2: (Adeno)carcinoma	22.8	**2:** Suspect sarcoma	20.0
	3: Lipoma	8.7	**3:** Mast cell tumor	11.7
Back	N = 50		N = 25	
	1: Suspect sarcoma	32.0	**1:** Suspect sarcoma	28.0
	2: Benign epithelial proliferation	18.0	**2:** Suspect Inflammation	20.0
	3: (Adeno)carcinoma	12.0	**3a:** (Adeno)carcinoma **3b:** (injection-site)Sarcoma	16.0
Mammary gland	N = 168		N = 60	
	1: (Adeno)carcinoma	79.2	**1:** (Adeno)carcinoma	91.7
	2: Benign epithelial proliferation	11.9	**2:** Benign epithelial proliferation	8.3
	3: Suspect sarcoma	3.0		
Perineum	N = 19		N = 14	
	1: (Adeno)carcinoma	57.9	**1:** (Adeno)carcinoma	64.3
	2a: Benign epithelial proliferation **2b:** Squamous cell carcinoma **2c:** Lymphoma	10.5	**2:** Lymphoma	14.3
	3a: Suspect sarcoma **3b:** Mast cell tumor	5.3	**3a:** Lipoma **3b:** Suspect sarcoma **3c:** Mast cell tumor	7.1
Tail	N = 27		N = 16	
	1: Suspect sarcoma	25.9	**1:** Mast cell tumor	31.3
	2: Benign epithelial proliferation	22.2	**2a:** Benign epithelial proliferation **2b:** (Adeno)carcinoma **2c:** Suspect sarcoma	18.8
	3: Mast cell tumor	18.5	**3a:** Squamous cell carcinoma; **3b:** Melanocytic proliferation	6.3

Table 19: The different age categories were plotted against the anatomical location. The age categories 0<-5 and 5-<10 were displayed in this table. The percentage of the three most common diagnoses, of each category combination, were calculated. Suspect sarcoma is "mesenchymal proliferation, suspect sarcoma", suspect inflammation is "mesenchymal proliferation, suspect inflammation".

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	2.42	1.50-3.90	0.0003
	British Shorthair	1.55	0.95-2.53	0.0801
	Maine Coon	0.84	0.51-1.39	0.4913
	Persian Cat	1.91	1.18-3.10	0.0089
	Norwegian Forest Cat	0.58	0.23-1.50	0.2634
	Other breeds	2.33	1.69-3.21	<0.0001

Table 20: Odds ratio of (adeno)carcinoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.18	0.05-0.75	0.0186
	British Shorthair	0.25	0.08-0.80	0.0195
	Maine Coon	0.39	0.17-0.89	0.0246
	Persian Cat	1.35	0.74-2.47	0.3346
	Norwegian Forest Cat	0.36	0.09-1.49	0.1586
	Other breeds	0.24	0.11-0.54	0.0006

Table 21: Odds ratio of squamous cell carcinoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.20	0.07-0.54	0.0015
	British Shorthair	0.70	0.39-1.25	0.2318
	Maine Coon	0.68	0.41-1.14	0.1426
	Persian Cat	0.40	0.19-0.83	0.0135
	Norwegian Forest Cat	0.88	0.40-1.92	0.7472
	Other breeds	0.35	0.21-0.59	0.0001

Table 22: Odds ratio of mesenchymal proliferation, suspect sarcoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.90	0.39-2.08	0.7971
	British Shorthair	1.41	0.72-2.76	0.3172
	Maine Coon	2.71	1.69-4.37	<0.0001
	Persian Cat	1.51	0.77-2.98	0.2283
	Norwegian Forest Cat	3.50	1.69-7.25	0.0008
	Other breeds	1.18	0.71-1.95	0.5222

Table 23: Odds ratio of benign epithelial proliferation pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	3.08	1.70-5.60	0.0002
	British Shorthair	1.63	0.80-3.30	0.1760
	Maine Coon	2.11	1.20-3.69	0.0093
	Persian Cat	0.35	0.09-1.44	0.1469
	Norwegian Forest Cat	1.10	0.34-3.60	0.8748
	Other breeds	1.25	0.73-2.16	0.4181

Table 24: Odds ratio of lymphoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.18	0.03-1.30	0.0892
	British Shorthair	0.67	0.25-1.86	0.4452
	Maine Coon	0.63	0.26-1.57	0.3210
	Persian Cat	0.72	0.26-1.99	0.5258
	Norwegian Forest Cat	1.93	0.75-4.99	0.1734
	Other breeds	0.47	0.21-1.08	0.0746

Table 25: Odds ratio of (injection-site)sarcoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	3.10	1.64-5.85	0.0005
	British Shorthair	1.97	0.97-4.01	0.0596
	Maine Coon	1.98	1.07-3.67	0.030
	Persian Cat	1.11	0.44-2.79	0.8210
	Norwegian Forest Cat	0.87	0.21-3.62	0.8430
	Other breeds	1.98	1.20-3.25	0.0074

Table 26: Odds ratio of mast cell tumor pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.15	0.01-2.46	0.1845
	British Shorthair	0.57	0.14-2.33	0.4309
	Maine Coon	0.42	0.10-1.73	0.2323
	Persian Cat	0.60	0.15-2.49	0.4855
	Norwegian Forest Cat	1.23	0.29-5.14	0.7812
	Other breeds	0.27	0.07-1.08	0.0639

Table 27: Odds ratio of mesenchymal proliferation, suspect inflammation pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.24	0.02-3.83	0.3096
	British Shorthair	0.88	0.21-3.65	0.8626
	Maine Coon	0.33	0.05-2.37	0.2682
	Persian Cat	1.43	0.44-4.62	0.5496
	Norwegian Forest Cat	0.93	0.13-6.84	0.9421
	Other breeds	0.41	0.10-1.69	0.2185

Table 28: Odds ratio of melanocytic proliferation pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	2.18	0.67-7.12	0.1954
	British Shorthair	1.29	0.31-5.37	0.7247
	Maine Coon	1.97	0.70-5.51	0.1973
	Persian Cat	1.38	0.33-5.74	0.6595
	Norwegian Forest Cat	0.65	0.04-10.68	0.7622
	Other breeds	1.86	0.79-4.35	0.1547

Table 29: Odds ratio of suspect lymphoma pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.96	0.30-3.08	0.9422
	British Shorthair	0.57	0.14-2.33	0.4309
	Maine Coon	0.64	0.20-2.05	0.4532
	Persian Cat	0.60	0.15-2.49	0.4855
	Norwegian Forest Cat	0.29	0.02-4.68	0.3799
	Other breeds	0.96	0.44-2.08	0.9091

Table 30: Odds ratio of Other/undefined diagnoses pedigree breeds compared to European Shorthair.

		Odds ratio	95% CI:	Significance level
European Shorthair	Siamese Cat	0.66	0.09-4.85	0.6867
	British Shorthair	1.21	0.29-5.04	0.7912
	Maine Coon	0.45	0.06-3.27	0.4289
	Persian Cat	0.64	0.09-4.66	0.6576
	Norwegian Forest Cat	1.28	0.17-9.43	0.8113
	Other breeds	3.61	1.92-6.82	0.0001

Table 31: Odds ratio of lipoma pedigree breeds compared to European Shorthair.