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Review article

Common tumors in cats: A comprehensive review of epidemiological and clinicopathological aspects

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Abstract

Feline tumors continue to be a rising problem in veterinary oncology. Knowledge of the actual epidemiological situation, circumstances of appearance and clinicopathological features of this pathology is essential to establish adequate diagnosis and preventive strategies, thus improving feline welfare. This review aims to update the current knowledge on three of the most common feline tumors: Squamous cell carcinoma (SCC), mammary tumors (MTs), and fibrosarcoma. For this, the recent epidemiological data published in scientific literature were summarized, potential risk factors incriminated in the occurrence of these tumors were explored, and their clinicopathological aspects were determined.

Keywords: Epidemiology, Feline, Review, Tumors, Veterinary oncology.

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INTRODUCTION

Cats represent an important pet population. They are reported as the most prevalent carnivores worldwide and among the most favored companion animals (Carvelli et al., 2016; Megna, 2024). According to recent animal population studies from North America, Europe and Australia, between 10.4%-56% households have at least one or more pet cats (Downes et al., 2009; Murray et al., 2015; Hardefeldt et al., 2018; Bir et al., 2020). These findings highlight the significant social and economic impact that feline pathology could potentially cause, particularly when it involves diseases of high mortality rates such as cancer (Kent et al., 2022).

Feline neoplasia has often been associated with a poor prognosis, as in this species, tumors were frequently reported to exhibit an aggressive biological behavior. In fact, studies have shown cats having four times higher odds of developing a malignant tumor compared to dogs (Pinello et al., 2022). However, to date, feline cancers have not received as much research attention as their canine counterparts. In fact, publications regarding feline tumors are, on average, four to five times fewer than those focusing on canine tumors. For instance, using the keywords "tumors" and "cat" in an advanced PubMed search yields 1370 articles. Conversely, substituting "cat" with "dog" in the same search generates 5945 articles. While, feline cancers may offer similar advantages to those found in dogs (naturally occurring cancer, shorter lifespan, similar environment as humans.) or even provide better opportunities for studying certain types of cancer in both general and comparative oncology fields.

Understanding feline neoplasia is crucial for enhancing the welfare of these animals. Identifying epidemiological characteristics and risk factors associated with cancer development in these species helps overcome diagnostic challenges and establish more effective prevention strategies. This article aims to provide a comprehensive overview of three of the most common feline tumor types: Squamous cell carcinoma (SCC), mammary tumors (MTs), and fibrosarcoma. Epidemiology, risk factors, and clinical features associated with these prevalent feline tumors will be investigated.

SQUAMOUS CELL CARCINOMA

Epidemiology

SCC is considered as one of the most common malignancies reported in cats (Table 1). It is defined as a neoplasm of epithelial cells with differentiation to keratinocytes (Rodrigez Guisado et al., 2021). The skin and oral cavity represent the most affected sites in cats (Graf et al., 2016; Wingo, 2018; Yamashita-kawanishi et al., 2018; Soltero-Rivera and Reiter, 2020). Other locations have also been reported to be affected, such as anal sac and trachea, but are considered less common (Miller et al., 2020; Kopke et al., 2021).

SCC occur predominantly in middle to older-aged animals, with an estimated average age of clinical presentation of 10.9 ± 3.4 years (Zambelli, 2015; Graf et al., 2016; Lino et al., 2019; Manuali et al., 2020; Rodrigez Guisado, 2021). However, SCC has also been reported in cats as young as 1 year old (Ho et al., 2018). No sex or breed predilection has been noted in cats (Graf et al., 2016; Yamashita-kawanishi et al., 2018). Nevertheless, longhaired breeds and Siamese were found to be less susceptible to cutaneous SCC as they are naturally protected from harmful ultraviolet (UV) light, with better hair cover and pigmentation of their ears and extremities, respectively (Dorn et al., 1971; Murphy 2013; Ho et al., 2018).

Associated risk factors

Chronic sunlight exposure has been considered as the most incriminated factor in the development of cutaneous SCC (Lino et al., 2019; Pérez-Enriquez et al., 2021). This finding was supported by the observed outdoor habits of various cat populations

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(Foreman-Worsley et al., 2021). In fact, studies from countries allowing a complete or semi-outdoor lifestyle for cats, have reported a high incidence of SCC (Kimura et al., 2012; Zambelli, 2015; Pérez-Enriquez et al., 2021). In contrast, countries with largely indoor cat populations, limiting their exposure to UV light, have reported lower incidence (Graf et al., 2016; Ho et al., 2018; Jung et al., 2019). Therefore, due to the correlation of SCC development and exposure to solar radiation, geographic location and outdoor habits will be expected to strongly influence the occurrence of SCC in cats.

Table 1 Epidemiological characteristics of the most common feline tumors in recent studies

Study location (Period)	Main findings	References
Squamous Cell Carcinoma (SCC)		
Italy (2013-2019)	- SCC was the most common malignancy among skin (69cases; 28.8%), oral cavity and tongue tumors (23cases; 46%) - Average age for cutaneous SCC= 10.2±3.2 and oral SCC= 11.3±3.2	(Manuali et al., 2020)
Mexico (2006-2018)	- SCC was the most common neoplasm in cats, making up 17% of cases (n=117) - Diagnosed in mature cats (7-10years)	(Pérez-Enriquez et al., 2021)
South Africa (1998-2005)	- 86% of all skin tumors were SCC - Domestic Shorthair cats demonstrated a significantly higher tendency to be diagnosed with SCC than other breeds (x2 = 13.374, df = 1, p = 0.00021) - 36/48 cases (75%) of SCC were diagnosed in White or Part-White cats	(Zambelli, 2015)
Mammary gland tumors		
Croatia (2009-2019)	- The most frequent diagnoses were mammary adenocarcinoma (106 cats, 19.0%) - No breed predisposition was found - Male/female ratio: 0.04	(Huber et al., 2024)
Thailand (2012-2019)	- The proportion of FMTs was 37.1% (36/97) for all feline tumor biopsy cases - The mean age of FMT cases was recorded at 9.0 ± 4.0 years - Mixed breed cats had the highest proportion of FMTs (75.0%) - Female cats were at a significantly higher risk of developing mammary gland tumors than male cats (OR=25.7, 95% CI [3.9–272.8], P < 0:0001).	(Srisawat et al., 2024)
UK (2016)	- The annual incidence risk of MT was 104 per 100,000 (0.104%, 95% CI [0.092-0.117] - Median age at diagnosis= 12years [5-23 years] - Cats with mammary tumors were found to be 1.5 times more likely to be purebred.	(Pickard Price et al., 2023)
Bulgaria (2000-2010)	- A total of 120 FMTs were diagnosed - Mixed breed cats were more affected (62.5%) - 117 cases (97.5%) were found in female cats and 3 (2.5%) in males - Age at diagnosis ranged between 8 and 12 years	(Simeonov and Grozeva, 2023)
Portugal (2019)	- FMTs were the most prevalent (43.7%, n= 207/475) - All mammary tumor were diagnosed in female cats	(Soares et al., 2021)
Fibrosarcoma		
UK (2006-2013)	- Prevalence (19.5%; n= 1766/9047) - Median age at diagnosis= 11years [1-25years] - Male:female ratio =0.96 - The Chinchilla was found to have significantly increased odds of developing fibrosarcoma compared with the non-pedigree cat population.	(Ho et al., 2018)
Switzerland (1965-2008)	- Prevalence (17.5%; n= 3209/18375) - Female cats had a significantly higher risk of developing a fibrosarcoma compared with male cats - In comparison with the European Shorthair cat, no breed had significantly higher odds of developing fibrosarcoma. However, some breeds had more than five times lower odds of developing fibrosarcoma.	(Graf et al., 2016)

Other factors were linked with feline SCC, including the use of flea collars or spot-on solutions, eating canned food, exposure to secondhand cigarette smoke, and

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infection with papillomavirus. However, the latter hypothesis remains a subject of controversy and more investigation is needed to confirm or refute a direct correlation (Wingo, 2018; Altamura et al., 2022). Additional details regarding factors associated with SCC in cats are provided in table 2.

Table 2 Risk factors associated with the development of the most frequent feline neoplasia

Risk factors	Main findings	References
Squamous Cell Carcinoma (SCC)		
Solar irradiation		
	Sunlight exposure was a significant risk factor for the development of cutaneous SCC White cats had a significantly higher risk (13.4 times greater) of developing cutaneous SCC compared with nonwhite cats	Dorn et al., 1971
Environmental contaminants		
	Cats that wore a flea collar had 5 times the risk of oral SCC (OSCC) as nonusers (RR = 5.3; P = .002)	Bertone et al., 2003
	On multivariable logistic regression, covariates significantly associated with an increased risk of OSCC were rural environment (OR: 1.77; 95% CI: 1.03-3.04; P =.04), outdoor access (OR: 1.68; 95% CI: 1.07-2.63; P =.02), and environmental tobacco smoke (OR: 1.77; 95% CI: 1.05-3; P =.03)	Zaccone et al., 2022
	Clumping clay cat litter and flea collar use were significant risk factors for feline oral SCC on multiple logistic regression with odds ratios of 1.66 (95% CI 1.20–2.30) and 4.48 (95% CI 1.46–13.75) respectively	Noall et al., 2023
Diet	Cats with high canned food intake had a 3-fold increase in risk of developing OSCC compared to cats eating mostly dry food (RR = 3.6; P= .014); canned tuna fish intake was independently associated with risk (RR = 4.7; P= 0.004)	Bertone et al., 2003
	An increased risk of OSCC and petfood containing chemical additives was noted (OR: 1.98; 95% CI: 1.04-3.76; P =0.04)	Zaccone et al., 2022
Viruses	Feline papillomavirus infection was associated with risk of cutaneous and oral squamous cell carcinoma	Yamashita et al., 2018; Carrai et al., 2020 ; Altamura et al., 2022
Mammary gland tumors		
Hormones and neuter status		
	Regular administration of progestogens was associated with an increased risk of both mammary carcinoma and benign mammary tumors	Misdorp et al., 1991
	Intact cats were at increased risk of having mammary carcinoma (OR=2.7, 95% CI = 1.4–5.3, P = 0.001)	Overley et al., 2005
	Data showed that cats had a 91% reduction in the risk of developing a feline mammary carcinoma if spayed prior to 6 months of age (OR = 0.9, 95% CI = 0.03–0.24)	
Fibrosarcoma		
Injection/ Trauma		
	The risk of developing fibrosarcomas was approximately 50% greater in vaccinated cats than in cats not receiving vaccines; this risk increases to >127% and to >175% with administration of two and three to four vaccines, respectively	Kass et al., 1993; Cecco et al., 2019
Viral induced		
	Feline sarcoma virus was incriminated in the development of multicentric fibrosarcoma	Hardy, 1981; Bonham et al., 1987

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Clinical signs and diagnosis

SCC arise mainly on sparsely haired, nonpigmented and sun-exposed areas of the skin, particularly the pinnae, eyelids, nasal planum, temples and lips (Figure 1A and 1B) (Murphy, 2013; Lino et al., 2019, dos Anjos et al., 2020; Rodrigez Guisado et al., 2021; Dos Santos et al., 2023). In the nasal area, the tumor is most often located on the surface and very rarely in the nasal cavities. As for oral SCC, lesions most often occur in the sublingual/lingual region, mandibular and maxillary gingiva, and tonsils (Pellin and Turek, 2016; Soltero-Rivera and Reiter, 2020).

This tumor may vary in appearance. It can present either as a proliferative form with a cauliflower-like growth, or as a non-healing shallow ulceration, evolving towards a deep crater (Murphy, 2013; Pellin and Turek, 2016; Dos Anjos et al., 2020; Soltero-Rivera and Reiter, 2020). Affected areas are often reddened, and the tumor tends to be locally invasive, sometimes involving the destruction of the cartilage and adjacent bone (Murphy, 2013; Lino et al., 2019; Kopke et al., 2021).

Clinical presentation is related to the location of the tumor; it may include rubbing or licking of the lesion, swelling, oral or nose bleeding, inappetence or dysphagia, halitosis, increased drool or oral discharge, constipation, weight loss, sneezing, or coughing (Wingo,2018; Miller et al., 2020; Soltero-Rivera and Reiter, 2020; Kopke et al., 2021; Rodríguez Guisado et al., 2021).

It is therefore essential to establish a differential diagnosis with other entities that may exhibit the same clinical features as SCC. These include other neoplasia (e.g., mast cell tumors, amelanotic melanoma, fibrosarcoma.), inflammatory lesions such as eosinophilic ulcers, pyogenic granuloma, and stomatitis for oral locations, as well as fungal infections frequently affecting the nasal planum (Figure 1C) (Soltero-Rivera and Reiter, 2020).

Final diagnosis is best achieved by biopsy as SCC exhibits distinctive histopathological features (Figure 1D). However, uncommon subtypes of SCC may appear, and in some cases, immunohistochemistry (IHC) is needed to identify the poorly differentiated neoplasms (e.g., spindle cell squamous cell carcinoma). Cytokeratins (CK5/6, AE1/AE3) and p63 protein are the most sensitive markers for SCC (Rodríguez Guisado et al., 2021).

Prognosis

SCC is an aggressive neoplasm, locally invasive but with low metastatic potential. However, when metastases occur, they typically arise in regional lymph nodes and, less frequently, in distant organs (Wingo, 2018; Kopke et al., 2021; Dos Santos et al., 2023).

This tumor is generally considered to carry a poor prognosis. The clinical outcome varies according to the affected site, and has been largely dependent on the degree of primary tumor invasion at diagnosis (Owen, 1980).

In fact, tumors located in accessible sites for complete surgical removal, such as the pinnae or nasal planum, have been reported to have a significantly better prognosis if detected and treated early (Dos Anjos et al., 2020). However, the only disadvantage that arises in these cases is the aesthetic outcome after surgery, which is poorly desired by owners (Dos Anjos et al., 2020; Rodríguez Guisado et al., 2021). Unfortunately, patients with tumors in a difficult location such as the oral cavity face a poor prognosis, as curative surgery is often not feasible, and the available therapy in these cases is largely only palliative in nature (Wingo, 2018; Lino et al., 2019).

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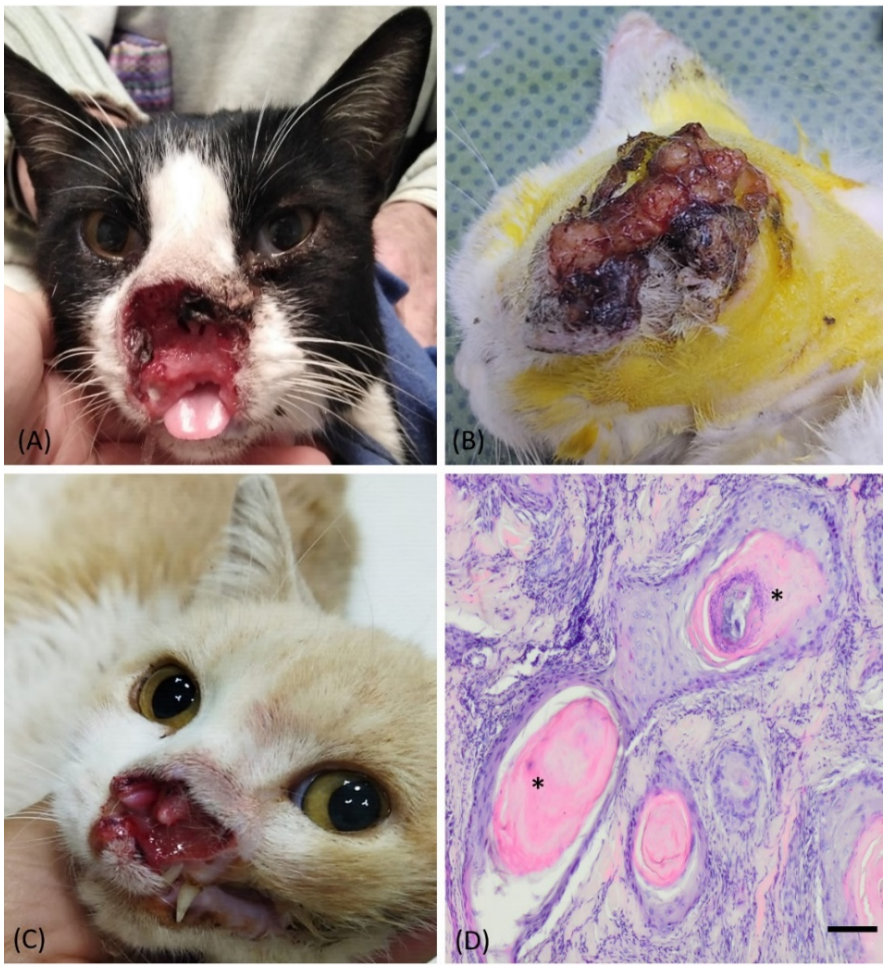

Figure 1 Feline squamous cell carcinoma, (A); Advanced ulceration with invasion of the nasal planum and rostral maxillary bone, (B); Lesion characterized by cauliflower-like growth and destruction of the pinnal cartilage, (C); Confirmed lesion of fungal infection in a 4-year-old cat, reminiscent of similar clinical appearance of SCC, (D); Well-differentiated SCC, notice the formation of distinct keratin "pearls'' (*) surrounded by neoplastic cells. Hematoxylin and Eosin. Bar= 100 µm. (Source: Dr. Nadia Laissaoui).

MAMMARY TUMORS

Epidemiology

MTs are common among cats and have ranked as the most prevalent neoplasm in various epidemiological studies (Table 1). During the last decades, the number of affected cases has notably increased. Actually, the estimated annual incidence has raised from 25 cases per 100.000 cats in an older reports, to 230/100.000 cats in more recent studies (Chocteau et al., 2019). The reported incidence rate was found to be significantly influenced by several factors, including geographic location, neuter status, husbandry practices, and socioeconomic factors (Pickard Price et al., 2023).

Adult animals are the most commonly affected, with a mean age of diagnosis ranging between 10-12 years (Chocteau et al., 2019; Dagher et al., 2019; Pickard Price et al., 2023). Exceptions among young individuals can also be observed, as evidenced by the diagnosis of a mammary tumor with pulmonary metastases in a 3-year-old cat (Hassan et al., 2017). The vast majority of feline mammary tumors (FMTs) are highly

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aggressive, usually accounting for a malignancy rate between 85-95% (Togni et al., 2013; Manuali et al., 2020; Pinello et al., 2022; Huber et al., 2024). They are significantly more prevalent in intact females and occur rarely in males (Graf et al., 2016; Soares et al., 2021; Simeonov et Grozeva, 2023; Huber et al., 2024; Srisawat et al., 2024).

Some studies have suggested FMTs to be more common in Domestic shorthair and Siamese cats (Cunha et al., 2016; Zappulli et al., 2021); however, these observations may depend on breed popularity across countries and owners' personal preferences, potentially introducing some bias (Simeonov et Grozeva, 2023; Srisawat et al., 2024).

Associated risk factors

The factors related to MTs in cats remain less clear in comparison to dogs. However, most studies have pointed neutering status, as is the case in dogs, as a major risk factor in feline mammary tumorigenesis. In fact, intact cats were reported to more likely develop MTs than neutered ones (Misdorp et al., 1991; Togni et al., 2013; Graf et al., 2016; Huber et al., 2024). But a study have showed that the protective effect of neutering can be obtained only when done early in life, as the risk of developing a mammary neoplasm increasing with each heat cycle. In fact, up to a 90% reduction in the risk of MTs development was observed if cats were spayed before 6 months of age, and no risk benefit was reported in cats spayed after 2 years of age (Overley et al., 2005) (Table 2).

Clinical signs and diagnosis

FMTs are presented as solitary or multiple masses, with multiple tumors more commonly being malignant and ipsilateral (Dagher et al., 2019; Zappulli et al., 2021; Simeonov and Grozeva, 2023; Masood et al., 2025). Tumors can range from small nodules (1.8cm x 1.3cm) to large masses (7.3cm x 4.2cm) and are usually firm and ulcerated (Figure 2A and 2B) (Cunha et al., 2016; Hassan et al., 2017; Zappulli et al., 2021; Pickard Price et al., 2023). All mammary glands can be affected, however, some studies have reported that the abdominal glands are the most at risk (Cunha et al., 2016; Sammarco et al., 2020).

Clinically, licking of the affected site is often observed. Cats may also show some nonspecific signs such as weight loss, inappetence, anorexia and depression as the disease progresses. In patients with thoracic metastases, signs of respiratory impairment, such us dyspnea, panting and cough, can be noticed (Petrucci et al., 2021; Pickard Price et al., 2023; Masood et al., 2025).

As the case for the majority of tumors, histological examination is crucial for establishing a final diagnosis. According to the most recent histological classification, FMTs are classified into five main groups: mammary hyperplasia/dysplasia; benign epithelial tumors, malignant epithelial tumors, malignant epithelial tumors-special types, malignant mesenchymal tumors and carcinosarcoma (Zappuli et al., 2021).

FMTs are most frequently simple carcinomas, with solid and tubulopapillary subtypes being the most common (Figure 2C) (Sammarco et al., 2020; Soares et al., 2021; Simeonov et Grozeva, 2023; Huber et al., 2024). Additional phenotyping is usually not needed, however, in case of unusual tumor presentation, IHC can be required (Dagher et al., 2019; Sammarco et al., 2020). Differential diagnosis should include other entities that may affect the mammary gland, mainly, feline mammary hypertrophy (otherwise known as fibroadenomatous hyperplasia), which can occur following prolonged metoestrus, pseudo pregnancy, pregnancy, or use of exogenous progesterone. Although the latter condition is more common in young cats and usually characterized by one or multiple enlarged mammary glands (Pickard Price et al., 2023).

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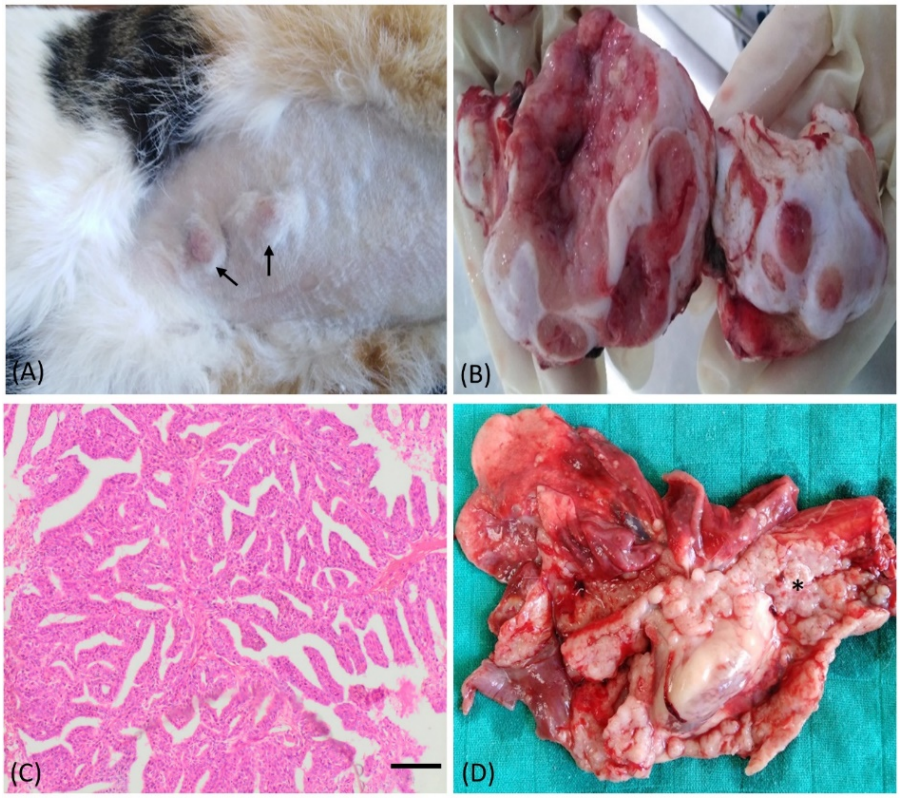

Figure 2 Mammary carcinoma in intact female cats, (A); Two firm nodules found at the abdominal mammary glands of the right mammary chain (Arrows), (B); Large ulcerated masses of the mammary gland causing discomfort and draining a seropurulent secretion, (C); Histological section of a mammary carcinoma. Abnormal proliferation of neoplastic cells, arranged in a tubulopapillary pattern. Hematoxylin and Eosin. Bar= 100 µm, (D); Metastasis of a mammary carcinoma (*), invading the lungs, pleura, pericardial sac and diaphragm. (Source: Dr. Nadia Laissaoui).

Prognosis

FMTs are largely malignant and generally associated with a poor prognosis, due to their high metastatic potential, and short survival time (Kent et al., 2022; Srisawat et al., 2024). Non-simple feline carcinomas were reported to exhibit a less aggressive behavior than the more common feline simple carcinomas (Mills et al., 2015; Sammarco et al., 2020).

Metastasis occur predominantly in the lungs and regional lymph nodes, alongside the pleura, pericardial sac and diaphragm (Figure 2D). Other locations were also noted, including the liver, kidney, adrenal glands, skeleton and spleen (Togni et al., 2013; Hassan et al., 2017; Petrucci et al., 2021).The survival time of cats affected by mammary tumors largely depends on various prognostic factors, which are assessed through two main systems:

- The clinical staging system of the World Health Organization, which considers factors such as tumor size, lymphatic nodes involvement, and distant metastasis (Owen, 1980), and;

- The histologic grading system adapted from the classification established by Elston and Ellis in 1991, which evaluates the degree of tubule formation, nuclear pleomorphism, and mitotic count (Elston and Ellis, 1991; Castagnaro et al., 1998). In recent reports, factors as lymphovascular invasion and nuclear form were also included (Mills et al., 2015; Dagher et al., 2019).

In most studies, the median reported survival time post-diagnosis of FMTs, ranged from 6 to 18 months (Castagnaro et al., 1998, Mills et al., 2015; Dagher et al.,

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2019; Pikard Price et al., 2023), and it was determined at 1 month in cases with metastasis (Petrucci et al., 2021).

FIBROSARCOMA

Epidemiology

Fibrosarcoma is a malignant neoplasm of the fibrous connective tissue. It is considered one of the most common tumors in aged and adult cats, with an approximate mean age at presentation of 9.7 years (Graf et al., 2016; Cecco et al., 2019). The skin, soft tissues, and oral cavity are reported to be the most commonly affected body locations (Wingo et al., 2018; White et al., 2020; Dobromylskyj et al., 2021). In fact, fibrosarcoma comprises 19.5–88.5% of feline cutaneous tumors and accounts for 9.8–17.0% of oral tumors (Graf et al., 2016; Ho et al., 2018; Harvey et al., 2022). Former studies have suggested no breed or sex predilection; however, recent reports from England and Switzerland have noted that some breeds had significantly lower odds of developing fibrosarcoma compared with non-pedigree and European shorthaired cat populations, respectively, and that female cats had significantly higher odds of developing this tumor compared to males (Graf et al., 2016; Ho et al., 2018) (Table 1).

Three types of fibrosarcoma were distinguished in cats. The most frequent type includes a proportion of feline injection-site sarcomas, commonly known as vaccine-associated fibrosarcoma. This is a well-recognized phenomenon in cats, with an estimated incidence of 1 to 10 affected cats per 1,000–12,500 cats vaccinated, yielding 300 to 2,000 cases per year (Dean et al., 2013; Kliczkowska et al., 2015; Cecco et al., 2019). The other types are spontaneous solitary fibrosarcoma arising mostly in older individuals, and multicentric or oncogene-induced fibrosarcoma, affecting young cats usually less than 5 years old. These types are considered less common, accounting for less than 2% of fibrosarcomas in cats, and their incidence seems to remain stable over time (Hardy, 1981; White et al., 2020).

Associated risk factors

Most mechanisms related to the development of fibrosarcomas remain uncertain. However, inappropriate and excessive inflammation induced in some cats after injections (of vaccines, long-acting antibiotics, steroids, meloxicam, cisplatin, microchip implantation, etc.) or trauma has been reported as a potential risk factor. It is hypothesized that the immune response of these cats presents an overexpression of growth factors and oncogene activation, resulting in chronic inflammation that underlies the neoplastic transformation of fibroblasts (Kliczkowska et al., 2015; Graf et al., 2016; Kang et al., 2017; Cecco et al., 2019).

As for multicentric fibrosarcoma, it has been reported that it usually occurs secondary to the feline sarcoma virus. The latter results from the combination of feline leukemia virus DNA with parts of the infected cat's own genome (Hardy, 1981; Bonham et al., 1987) (Table 2).

Clinical signs and diagnosis

During routine clinical examination, cats are often presented with unique masses, commonly located in the scapular region, caudal neck, lumbar and sacral regions, flanks and hind limbs. Tumors can be small or large in size, circumscribed or largely infiltrative (Cecco et al., 2019). Fibrosarcomas have in general a firm consistency, and may present cystic spaces and superficial ulceration within the mass (Figure 3A) (Kliczkowska et al., 2015; Cecco et al., 2019; Harvey et al., 2022).

Microscopically, these tumors can range from well-differentiated, with spindle-shaped tumor cells arranged in interwoven patterns, uniform and elongated to oval nuclei with inconspicuous nucleoli and infrequent mitotic figures, to anaplastic tumors characterized by marked cellular and nuclear pleomorphism, with frequent presence of polygonal, multinucleated giant cells and an increased number of mitotic figures (Figure

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3B) (White et al., 2020; Harvey et al., 2022). IHC can be used to differentiate fibrosarcomas from other entities, mainly leiomyosarcoma and peripheral nerve sheet tumors (Cora et al., 2017; de Carvalho Cid et al., 2022). Neoplastic cells exhibit positive labeling for vimentin. However, as the majority of mesenchymal tumors typically stain positive for vimentin, additional antibody panels (such as Prot S100, Smooth Muscle Actin, Desmin, Melan A) are often necessary to rule out other types of tumors (de Carvalho Cid et al., 2022; Harvey et al., 2022).

Moreover, differential diagnosis should include non-neoplastic conditions such as eosinophilic granuloma, especially with injection site sarcoma, as well as the syndrome of benign mandibular swelling, which can mimic oral neoplasia in cats (Mulherin et al., 2024).

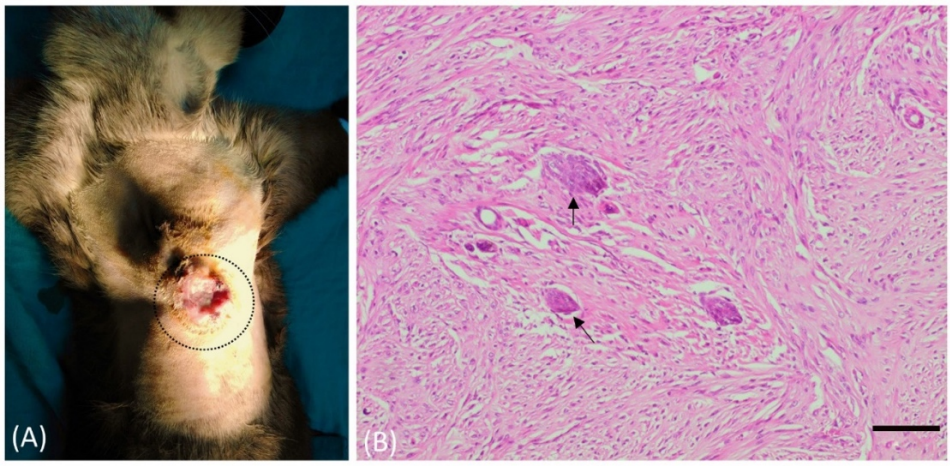

Figure 3 Fibrosarcoma in a 9-year-old cat, (A); Vaccine-associated fibrosarcoma, showing an ulcerated, firm, recurrent mass in the interscapular region, (B); Histological section showing the spindle-shaped tumor cells arranged in interwoven patterns and the presence of multinucleated giant cells (Arrows). Hematoxylin and Eosin. Bar= 100 µm. (Source: Dr. Nadia Laissaoui).

Prognosis

Fibrosarcoma is described as a typically aggressive neoplasm that exhibits important tissue invasion. In fact, despite surgical resection and adjuvant therapy, local recurrence is common and generally causes severe pain, functional impairment, and discomfort for the animal. In most cases, this leads to euthanasia to prevent further suffering (Cecco et al., 2019; Dobromylskyj et al., 2021; de Carvalho Cid et al., 2022).

CONCLUSIONS

Tumors in cats are becoming an important part of routine veterinary consultations, and their incidence continues to increase globally over the years. The majority have a reserved prognosis and result in severe health consequences. The present work may be highly useful for veterinary practitioners, as it aims to present the current epidemiological situation of the most prevalent feline tumors and the associated risk factors in order to understand the circumstances behind the occurrence of these tumors. Additionally, knowledge of various diagnosis options allows for early cancer management and vigilant surveillance, ultimately improving outcomes and quality of life for feline populations.

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AUTHOR CONTRIBUTIONS

NL: Conceptualization, Visualisation, Writing – original draft.
DSB, YM, RA, NT: Supervision, Validation, Review & Editing.
MEM: Investigation, Review & Editing.

CONFLICT OF INTEREST

The authors declared no conflicts of interest in relation to the research, authorship and publication of this paper.

REFERENCES

Altamura, G., Cuccaro, B., Eleni, C., Strohmayer, C., Brandt, S., Borzacchiello, G., 2022. Investigation of multiple Felis catus papillomavirus types (-1/-2/-3/-4/-5/-6) DNAs in feline oral squamous cell carcinoma: a multicentric study. J. Vet. Med. Sci. 84(6), 881–884.

Bertone, E.R., Snyder, L.A., Moore, A.S., 2003. Environmental and lifestyle risk factors for oral squamous cell carcinoma in domestic cats. J. Vet. Intern. Med. 17(4), 557-562.

Bir, C., Ortez, M., Olynk Widmar, N.J., Wolf, C.A., Hansen, C., Ouedraogo, F.B., 2020. Familiarity and use of veterinary services by US resident dog and cat owners. Animals. 10(3), 483.

Bonham, L., Lobellerich, P.A., Henderson, L.A., Levy, L.S., 1987. Transforming potential of a myc-containing variant of feline leukemia-virus in vitro in early passage feline cells. J. Virol. 61(10), 3072–3081.

Carrai, M., Van Brussel, K., Shi, M., Li, C.X., Chang, W.S., Munday, J.S., Voss, K., McLuckie, A., Taylor, D., Laws, A., Holmes, E.C., Barrs,V.R., Beatty, J.A., 2020. Identification of a novel papillomavirus associated with squamous cell carcinoma in a domestic cat. Viruses. 12(1), 124.

Carvelli, A., Iacoponi, F., Scaramozzino, P., 2016. A cross-sectional survey to estimate the cat population and ownership profiles in a semirural area of central Italy. Biomed. Res. Int. 2016, 3796872.

Castagnaro, M., Casalone, C., Bozzetta, E., De Maria, R., Biolatti, B., Caramelli, M., 1998. Tumour grading and the one-year post-surgical prognosis in feline mammary carcinomas. J. Comp. Pathol. 119(3), 263–275.

Cecco, B.S., Henker, L.C., De Lorenzo, C., Schwertz, C.I., Bianchi, R.M., da Costa, F.V.A., Sonne, L., 2019. Epidemiological and pathological characterization of feline injection site sarcomas in southern Brazil. J. Comp. Pathol. 172, 31-36.

Chocteau, F., Boulay, M.M., Besnard, F., Valeau, G., Loussouarn, D., Nguyen, F., 2019. Proposal for a histological staging system of mammary carcinomas in dogs and cats. Part 2: feline mammary carcinomas. Front. Vet. Sci. 6, 387.

Cora, R., Gal, A.F., Taulescu, M., Tăbăran, F., Vidrighinescu, R., Cătoi, C., 2017. Description of a feline injection-site fibrosarcoma with metastasis in the cerebellum. Acta. Vet. (Beogr). 67, 578-586.

Cunha, S., Corgozinho, K., Justen, H., Silva, K., Leite, J., Ferreira, A.M., 2016. Survival and disease-free interval of cats with mammary carcinoma treated with chain mastectomy. Acta. Sci. Vet. 44, 1-8.

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Dagher, E., Abadie, J., Loussouarn, D., Campone, M., Nguyen, F., 2019. Feline invasive mammary carcinomas: prognostic value of histological grading. Vet. Pathol. 56, 660-670.

Dean, R.S., Pfeiffer, D.U., Adams, V.J., 2013. The incidence of feline injection site sarcomas in the United Kingdom. BMC. Vet. Res. 9, 17.

de Carvalho Cid, G., de Brito Jardim, M.P., Fernandes, M.E.D.S.L., Bastos, P.A.D.L.M., Santos, C.R.G.R., Lorenço, M., Nogueira, V.A., Souza, H.J.M., 2022. Primary Intestinal Fibrosarcoma in Cats. Acta. Sci. Vet. 50, 828.

Dobromylskyj, M.J., Richards, V., Smith, K.C., 2021. Prognostic factors and proposed grading system for cutaneous and subcutaneous soft tissue sarcomas in cats, based on a retrospective study. J. Feline. Med. Surg. 23, 168-174.

Dorn, C.R., Taylor, D.O., Schneider, R., 1971. Sunlight exposure and risk of developing cutaneous and oral squamous cell carcinomas in white cats. J. Natl. Cancer. Inst. 46, 1073–1078.

Dos Anjos, D.S., Sierra, O.R., Spugnini, E.P., De Nardi, A.B., Fonseca-Alves, C.E., 2020. Comparison of two different doses of bleomycin in electrochemotherapy protocols for feline cutaneous squamous cell carcinoma nonsegregated from ultraviolet light exposure. Sci. Rep. 10(1), 18362.

Dos Santos, A., Lamego, E.C., Eisenhardt, L.M., de Vargas, I., Flores, M.M., Fighera, R.A., Kommers, G.D., 2023. Prevalence and anatomopathological characterization of cutaneous squamous cell carcinomas with regional and distant metastases in dogs and cats: 20 cases (1985–2020). Vet. Comp. Oncol. 21(2), 291-301.

Downes, M., Canty, M.J., More, S.J., 2009. Demography of the pet dog and cat population on the island of Ireland and human factors influencing pet ownership. Prev. Vet. Med. 92, 140-149.

Elston, C.W., Ellis, I.O., 1991. Pathological prognostic factors in breast cancer: I. The value of histological grade in breast cancer: experience from a large study with long-term follow-up. Histopathology. 19(5), 403–410.

Foreman-Worsley, R., Finka, L.R., Ward, S.J., Farnworth, M.J., 2021. Indoors or outdoors? an international exploration of owner demographics and decision making associated with lifestyle of pet cats. Animals. 11(2), 253.

Graf, R., Gruntzig, K., Boo. G., Hässig, M., Axhausen, K.W., Fabrikant, S., Welle, M., Meier, D., Guscetti, F., Folkers, G., Otto, V., Pospischil, A., 2016. Swiss feline cancer registry 1965–2008: the influence of sex, breed and age on tumour types and tumour locations. J. Comp. Pathol. 154(2-3), 195-210.

Hardefeldt, L.Y., Selinger, J., Stevenson, M.A., Gilkerson, J.R., Crabb, H., Billman-Jacobe, H., Browning, G.F., 2018. Population wide assessment of antimicrobial use in dogs and cats using a novel data source–a cohort study using pet insurance data. Vet. Microbiol. 225, 34-39.

Hardy, W.D., 1981. The feline sarcoma viruses. J. Am. Anim. Hosp. Assoc. 17, 981-997.

Harvey, A., Soukup, J.W., Bell, C.M., 2022. Feline maxillary sarcoma: clinicopathologic features of spindle cell sarcomas from the maxilla of 25 cats. J. Feline. Med. Surg. 24, e647-e654.

Hassan, B.B., Elshafae, S.M., Supsavhad, W., Simmons, J.K., Dirksen, W.P., Sokkar, S.M., Rosol, T.J., 2017. Feline mammary cancer: novel nude mouse model and molecular characterization of invasion and metastasis genes. Vet. Pathol. 54(1), 32-43.

Ho, N.T., Smith, K.C., Dobromylskyj, M.J., 2018. Retrospective study of more than 9000 feline cutaneous tumours in the UK: 2006–2013. J. Feline. Med. Surg. 20(2), 128-134.

Huber, D., Severin, K., Vlahović, D., Križanac, S., Mofardin, S., Buhin, I.M., Zagradišnik, L.M., Šoštarić-Zuckermann, I.C., Kurilj, A.G., Artuković, B., Hohšteter, M., 2024. Cancer morbidity in Croatian cats: Retrospective study on spontaneously arising tumors (2009–2019). Top. Companion. Anim. Med. 58, 100841.

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Jung, J.Y., Ko, K.R., Choi, Y.M., Jang, S.H., Kim, J.H., 2019. A retrospective study of feline cutaneous tumors in Korea from 2013 to 2018. Korean. J. Vet. Res. 59, 187-193.

Kang, S., Southard, T., Hume, K.R., 2017. DNA damage is a feature of feline injection-site sarcoma. Vet. Comp. Oncol. 15, 518e524.

Kass, P.H., Barnes, W.G., Spangler, W.L., Chomel, B.B., Culbertson, M.R., 1993. Epidemiologic evidence for a causal relation between vaccination and fibrosarcoma tumorigenesis in cats. J. Am. Vet. Med. Assoc. 203, 396–405.

Kent, M.S., Karchemskiy, S., Culp, W.T., Lejeune, A.T., Pesavento, P.A., Toedebusch, C., Rebhun, R., 2022. Longevity and mortality in cats: a single institution necropsy study of 3108 cases (1989–2019). PLoS One. 17(12), e0278199.

Kimura, K.C., Gárate, A.P., Dagli, M.L.Z., 2012. Retrospective study of neoplasms in domestic animals: A survey between 1993 and 2002 of the service of animal pathology, department of pathology, school of veterinary medicine and animal science, University of Sao Paulo, Southeast Brazil. Braz. J. Vet. Pathol. 5(2), 60-69.

Kliczkowska, K., Jankowska, U., Jagielski, D., Czopowicz, M., Sapierzynski, R., 2015. Epidemiological and morphological analysis of feline injection site sarcomas. Pol. J. Vet. Sci. 18(2), 313-322.

Kopke, M.A., Gal, A., Piripi, S.A., Poirier, V.J., 2021. Squamous cell carcinoma of the anal sac in two cats. J. Small. Anim. Pract. 62(8), 704-708.

Lino, M., Lanore, D., Lajoinie, M., Jimenez, A., Crouzet, F., Queiroga, F.L., 2019. Prognostic
factors for cats with squamous cell carcinoma of the nasal planum following high-dose-rate brachytherapy. J. Feline. Med. Surg. 21(12), 1157-1164.

Masood, W., Ali, A.W., Shaheen, A., Zulfiqar, A., Haq, M.S.U., Raza, S. A., Ashraf, A., 2025. The Protein Biomarkers of Feline Mammary Carcinoma. Vet. Integr. Sci. 23(1), 1-25.

Megna, M., 2024. Pet Ownership Statistics 2024. Available from: https://www.forbes.com/advisor/pet-insurance/pet-ownership-statistics/

Miller, Z.A., Padgett, S., Terreros, A., Pearce, E., 2020. Tracheal squamous cell carcinoma treated with tracheal resection and anastomosis in a cat. Cas. Rep. Vet. Med. 2020, 8818660.

Mills, S.W., Musil, K.M., Davies, J.L., Hendrick, S., Duncan, C., Jackson, M.L., Kidney, B., Philibert, H., Wobeser, B.K., Simko, E., 2015. Prognostic value of histologic grading for feline mammary carcinoma: a retrospective survival analysis. Vet. Pathol. 52(2), 238–249.

Misdorp, W., Romijn, A., Hart, A.A., 1991. Feline mammary tumors: a case-control study of hormonal factors. Anticancer. Res. 11(5), 1793-1797.

Mulherin, B.L., 2024. Interpretation of uncommon pathology in the canine and feline patient. In: Mulherin B.L., Miles, C., Congiusta, M. (Eds), Veterinary oral diagnostic imaging. Wiley Blackwell, Iowa, pp. 235-263.

Murphy, S., 2013. Cutaneous squamous cell carcinoma in the cat current understanding and treatment approaches. J. Fel. Med. Surg. 15(5), 401–407.

Murray, J.K., Gruffydd-Jones, T.J., Roberts, M.A., Browne, W.J., 2015. Assessing changes in the UK pet cat and dog populations: Numbers and household ownership. Vet. Rec. 177(10), 259.

Noall, L., Lee, S., Burton, J.H., Marquardt, T.M., Cermak, J., Thombs, L.A., Chu, S., 2023. A multi-institutional epidemiologic study evaluating environmental risk factors for feline oral squamous cell carcinoma. Vet. Comp. Oncol. 21(3), 509-519.

Overley, B., Shofer, F.S., Goldschmidt, M.H., Sherer, D., Sorenmo, K.U., 2005. Association between ovariohysterectomy and feline mammary carcinoma. J. Vet. Intern. Med. 19(4), 560-563.

Owen, L.N., 1980. TMN classification of tumors in domestic animals. World Health Organization, Geneva, pp. 46–53.

Pellin, M., Turek, M., 2016. A Review of feline oral squamous cell carcinoma. T. Vet. Pract. 6, 24-31.

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Pérez-Enriquez, J.M., Romero-Romero, L., Alonso-Morales, R.A., Fuentes-Pananá, E.M., 2021. Tumor prevalence in cats: experience from a reference diagnostic center in Mexico City (2006-2018). Vet. México. 7(4), 1-14.

Petrucci, G., Henriques, J., Gregório, H., Vicente, G., Prada, J., Pires, I., Lobo, L., Medeiros, R., Queiroga, F., 2021. Metastatic feline mammary cancer: prognostic factors, outcome and comparison of different treatment modalities–a retrospective multicentre study. J. Feline. Med. Surg. 23(6), 549-556.

Pickard Price, P., Stell, A., O'Neill, D., Church, D., Brodbelt, D., 2023. Epidemiology and risk factors for mammary tumours in female cats. J. Small. Anim. Pract. 64(5), 313-320.

Pinello, K., Amorim, I., Pires, I., Canadas-Sousa, A., Catarino, J., Faísca, P., Niza-Ribeiro, J., 2022. Vet-OncoNet: Malignancy analysis of neoplasms in dogs and cats. Vet. Sci. 9(10), 535.

Rodríguez Guisado, F., Suárez-Bonnet, A., Ramírez, G.A., 2021. Cutaneous spindle cell squamous cell carcinoma in cats: clinical, histological, and immunohistochemical study. Vet. Pathol. 58(3), 503-507.

Sammarco, A., Finesso, G., Zanetti, R., Ferro, S., Rasotto, R., Caliari, D., Goldschmidt, M.H., Orvieto, E., Castagnaro, M., Cavicchioli, L., Zappulli, V., 2020. Biphasic feline mammary carcinomas including carcinoma and malignant myoepithelioma. Vet. Pathol. 57(3), 377–387.

Simeonov, R., Grozeva, I., 2023. Epidemiological retrospective studies of feline mammary gland tumours in Bulgaria. Bulg. J. Vet. Med. 1311-1477.

Soares, M., Marques, C., Catarino, J., Batista, M.R., Catita, J., Faisca, P., 2021. National survey of cat tumors in 2019: a retrospective study. Rev. Lusófona. Ciênc. Med. Vet. 11, 14–19.

Srisawat, W., Pringproa, K., Prachasilchai, W., Thongtharb, A., Sthitmatee, N., 2024. Epidemiology and classification for canine and feline mammary gland tumors: a histopathological survey of 437 mammary gland tumor biopsies performed in a secondary care hospital in Chiang Mai, Thailand from 2012 to 2019. Peer J. 12, e17077.

Togni, M., Masuda, E.K., Kommers, G.D., Fighera, R.A., Irigoyen, L. F., 2013. A retrospective study of 207 cases of mammary tumors in queens. Pesqui. Vet. Bras. 33, 353-358.

White, M.E., Yang, C., Hokamp, J.A., Wellman, M.L., 2020. Fibrosarcoma with sarcomatosis and metastasis in a FeLV-negative cat. Vet. Clin. Pathol. 49, 143-146.

Wingo, K., 2018. Histopathologic diagnoses from biopsies of the oral cavity in 403 dogs and 73 cats. J. Vet. Dent. 35(1), 7-17.

Yamashita-kawanishi, N., Sawanobori, R., Matsumiya, K., Uema, A., Chambers, J.K., Uchida, K., Haga, T., 2018. Detection of felis catus papillomavirus type 3 and 4 DNA from squamous cell carcinoma cases of cats in Japan. J. Vet. Med. Sci. 80(8), 1236–1240.

Zaccone, R., Renzi, A., Chalfon, C., Lenzi, J., Bellei, E., Marconato, L., Ros, E., Rigillo, A., Bettini, G., Faroni, E., Guerra, D., Sabattini, S., 2022. Environmental risk factors for the development of oral squamous cell carcinoma in cats. J. Vet. Intern. Med. 36(4), 1398–1408.

Zambelli, A.B., 2015. Feline cancer prevalence in South Africa (1998-2005): contrasts with the Rest of the World. Int. J. Basic. Appl. Sci. 11, 370.

Zappulli, V., Pena, L., Rasotto, Goldschmidt, M.H., Gama, A., Scruggs, L.L., Kiupel, M., 2021. Mammary tumours, surgical pathology of tumors of domestic animals. Davis Thomson Foundation, Gurnee, IL.

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