

Feline Mammary Tumors Across Five Countries: A Comparative Literature Review

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Abstract. Feline Mammary Tumors (FMTs) are one of the most frequent forms of cancers in cats, having a tendency to be highly malignant. Many studies are dedicated to the pathophysiology, diagnostic and therapy of these tumors, with mastectomy being the key method for therapy due to the aggressive nature of the disease. Early ovariohysterectomy is considered to be the most efficient way to prevent the occurrence of FMTs. Nevertheless, the epidemiological characteristics (incidence, therapy, and results) are different in various countries. Thus, this review aims to examine literature about FMTs from Italy, Morocco, Brazil, Thailand, and South Korea in order to compare the difference in the epidemiology and treatment of the disease. Though the methods of research and the sources of information differ, FMTs affect old, non-neutered females; moreover, the malignancy rate is more than 83%. Such discrepancy is caused by different accessibility of veterinary care, level of owner's education, preventive measures, and culture of castration.

Keywords: Feline Mammary Tumors, Early Ovariohysterectomy, Standardized Multi-country Epidemiological Studies

1. Introduction

Feline mammary gland tumors (FMTs) are within the top three most common tumor types in felines [1]. It is more susceptible to intact female cats [2] aged between 10–12 years old because of the exposure to hormones [3] and is rare in male cats. In male cats, the common presentation is around 12.8 years old [4]. Siamese cats have a genetic disposition toward feline mammary tumors [1], while domestic shorthaired (DHS) cats also report high incidence rate due to its large population size [5]. Cats with FMT often exhibit systemic symptoms including lethargy and decreased appetite [6]. Plus, Mammary lesions can develop unilaterally or bilaterally, with tumor sizes ranging from <2 cm to >3 cm [7]. However, because early-stage tumors are typically less than 1 cm in diameter [3], they are often difficult for owners to detect beneath a cat's thick fur. Consequently, histopathological examination of biopsy samples remains the most reliable diagnostic method for evaluating cellular characteristics [8]. Among all the feline mammary tumors, around 85 to 95 percent of them are malignant, metastasizing rapidly to regional lymph nodes in most cases [3] and major tumor types include tubulopapillary carcinoma, cribriform carcinoma, and malignant adenomyoepithelioma [7].

Therefore, treatments are essential, including radical surgeries such as partial, unilateral, and bilateral mastectomy to radically remove the cancer cells [9], and conservative treatments such as

lumpectomy [10] or chemotherapy [3]. Still, there is some controversy over how different methods will affect the prognosis of cats with FMT, but it can be sure that the larger the tumor is, the shorter the median survival time is. To further prevent FMT from happening, neutering is recommended. Performing ovariohysterectomy can decrease the chance of developing FMT by different extents according to the cat's age: when a cat is aged less than 6 months, it lowers the risk by 91%; when a cat is aged between 6 and 12 months, by 86%; and when a cat is aged between 13 and 24 months, by 11% [11].

Noteworthy, across at least 5 countries, including Western countries and Asian countries such as China, Korea, and Thailand, discrepancies in FMT epidemiology are present, started with incidence rates. Neuter rates differ worldwide, contributing to different incidence rates. First, there might be an association between the knowledge of ovariohysterectomy and neuter rate. Pet owners may have been educated with knowledge about animals at different levels and extents. Second, a gap in medical care is present. Prices for neuter surgeries vary significantly across countries [12]. This may contribute to low neuter rate since some pet owners are reluctant to pay the high fees. Third, cultural beliefs can influence the owners' decisions. For example, in China, the neutering rate is lower, since people believe bodies given by parents should not be easily changed influenced by traditional Confucian values, e.g., the Classic of Filial Piety [13], causing them to be reluctant to neuter their cats. Besides incidence rates, other aspects regarding FMT epidemiology including survival time and management differ notably, which will also be discussed in detail in following paragraphs.

However, there is a limited amount of current literature that provides evidence to explain the reasons behind these geographical discrepancies. Therefore, this research paper is constructed to discuss the multi-faceted differences through analyzing all these aspects so that incidence can be minimized and outcomes can be improved. By addressing these gaps, this study seeks to support better prevention, clinical guidance, and animal welfare which focuses on animals' physical and mental health, emotions, basic survival needs, behaviors, and intrinsic values [14].

This literature is constructed by searching key words on Edge and Google, search engines: "Feline mammary gland history study"; "feline mammary gland, treatment study"; "feline mammary gland, prevention, neutering study"; "feline mammary gland, epidemiology study"; "medical care for pets, different countries study"; "Animal welfare study"; "feline mammary gland tumor lethargy study".

2. Results

Table 1. Feline mammary gland tumors study from different five countries

Data Section	Italy	Morocco	Brazil	Thailand	Korea
Frequency / Proportion	Most represented tumor in female cats	20.4% of feline neoplasms	Mammary-lesion-only study	37.1% of feline tumor biopsies	Not national incidence
Diagnostic Standard	Histopathology	Histopathology	Histopathology	Histopathology	Histopathology

Table 1. (continued)

Data Source	Liguria regional registry; 4,399 cats	49 feline tumors from 250-case study	418 cats; 858 mammary lesions	36 FMTs from 97 feline tumor biopsies (out of 437 total MGTs)	683 cats with 689 tumors from Konkuk University Dept. of Veterinary Pathology (2012-2022)
Risk Factors	Non-neutered females	Age 10; female; mixed breed	Older cats; crossbreeds	Female cats; OR 25.7	Older cats
Tumor Behavior	No mammary malignancy rate reported	Frequent feline neoplasm	88.8% malignant in study	83.3% malignant	93.1% malignant
References	Giugliano et al. (2024)	Laissaoui et al. (2024)	Souza et al. (2024)	Srisawat et al. (2024)	Seung et al. (2024)

In Table 1, the data on feline mammary gland tumors from five data sections (frequency/proportion, diagnostic standard, data source, risk factors, and tumor behavior) are compared between five countries: Italy, Morocco, Brazil, Thailand, and Korea. The sections indicate that mammary tumors are significant in different parts of the world but are not to be interpreted as direct national incidence rates. The studies employed various approaches: Italy and Korea employed large tumor datasets, Morocco employed a prospective tumor group, Thailand employed hospital biopsy data, and Brazil employed only mammary lesions. The data should thus be interpreted as results of studies and not as rates of disease nationwide.

Useful information on the distribution and prevention of tumors is available in Italy, summarized in Table 1. From 2002 to 2022, 4,399 cats participated in the registry in Liguria. Mammary gland tumors were the most common adult female tumor and were more prevalent in non-castrated than in castrated female cats. The Italian study does not report the exact percentage of mammary malignancies; it is therefore more informative for discussing risk factors than prognosis, with all diagnoses confirmed via histopathology [15].

Morocco makes an important non-Western comparison; however, data about feline tumors in the region remain limited. Table 1 shows that a total of 250 tumors were included in the study, of which 49 were feline tumors. Mammary carcinoma accounted for 20.4% of feline neoplasms. The study also noted that the median age of cats at diagnosis was 10 years, females were overrepresented, and most cats were mixed breed. Despite the small sample size, the finding that mammary carcinoma is relevant in Morocco is significant, as determined through histopathological examination [16].

Brazil offers strong mammary-specific evidence as the study was centered specifically on feline mammary lesions, comprising 418 cats and 858 mammary lesions with diagnosis made by histopathology (Table 1). In this dataset, 88.8% of cats had malignant mammary neoplasms. Cats with malignant lesions tended to be older (mean age 10.2 ± 3.4 years) and most were crossbred [7].

Thailand also provides primary mammary tumor data. Summarized in Table 1, the dataset from Chiang Mai University indicated that 37.1% of feline tumor biopsy samples were feline mammary tumors, with 83.3% being malignant. Females were significantly more likely than males to be affected, with an odds ratio of 25.7 [17].

Korea provides another Asian comparison (Table 1). The Korean study involved 683 cats and found that older cats were more likely to have malignant tumors. The malignancy rate of mammary gland tumors exceeded 90%, consistent with the rates reported in Brazil and Thailand [18].

3. Discussion

In all five countries considered, feline mammary tumors are mostly a disease seen in older female cats where the percentage of malignancies is always greater than 83% [3, 17, 18]. Although there seems to be similarities in terms of the clinical aspects, some differences are seen in the design and epidemiology pattern among the different countries [15, 16].

Another major factor contributing to the differences between countries in terms of FMT occurrence rate is the difference in neutering rates that, in turn, depend on pet owners' education level. Early ovariohysterectomy conducted at less than 6 months of age lowers the risk of FMT by 91% [11]. The data from Liguria showed that female dogs that had not undergone neutering accounted for a larger number of FMT cases, and thus the high neutering rate in Western Europe can explain the relatively low prevalence of FMT in that region [15]. However, the three other datasets used in the study come from hospitals and pathology records and, therefore, include mostly advanced cases of FMT, which can also indicate lower neutering rates in Morocco, Thailand, and Brazil. Lower neutering rates can be caused by the lower public awareness about the protective effect of neutering because there is a lack of preventive veterinary services in these regions. For instance, the veterinary educational program in China historically focused on agriculture and farm animals, which means that the population lacks the necessary information concerning prevention of diseases in pets [19]. Unawareness of the connection between intact status and risk of mammary tumors will mean that pet owners are unlikely to seek to neuter their feline companions at an early age. Education programs aimed at cat owners especially those in countries with low levels of veterinary awareness may prove a valuable way forward in preventing FMTs.

Another reason for the noted differences is the uneven provision of veterinary care in different countries. The cost of neutering procedures and oncology diagnostics is significantly different in various countries [12], which means that in poorer regions, animal owners will not visit veterinarians until the tumors reach an advanced stage because of their high prices. The financial problem is present not only in poorer regions – according to the survey of 766 pet owners conducted in South Korea, where veterinary healthcare facilities are advanced, the price of the veterinary services was one of the most significant predictors of caregiver burden, and the condition of pets had a strong impact on expenses [20]. Financial issues are not the only reasons why there are differences in neutering, access to information, cultural views, and attitude to veterinarians also influence pet owners' decisions. This situation is in line with the difference that is evident in the data since studies in Brazil and Thailand which analyze biopsy samples in hospitals report high malignancy (88.8% and 83.3%) respectively. Biopsy and histopathology are the methods employed after surgical removal of the mass and are done in specialized referral hospitals when the mass is suspicious. As such, the biopsy database in hospitals includes a larger percentage of advanced and malignant tumors than the whole general population. In addition, the diagnostic procedures used in different countries differ where Italy uses population database and others use samples collected from histopathology samples of referral hospitals. Therefore, due to the different diagnostic methods used in different countries, the data represents a different subset of the feline population. Data collected by means of a registry in Italy represents the general population while the hospital-based data represents only cats which have undergone examination in hospitals in Brazil, Thailand, and Korea.

Cultural beliefs form a third axis on the epidemiology of FMT in different nations. In Chinese culture and other societies that follow the teachings of Confucianism, the resistance to change the body by neutering may be because of the belief of filial piety (xiao) mentioned in the Classic of Filial Piety (Xiaojing): "The body, hair, and skin are received from our parents, and it is not proper to destroy and injure them". Hence, early Confucianism considered the integrity of the body as the foremost sign of xiao and the rites and the care of the body formed the basic obligation of xiao [13]. This results in reduced rates of neutering and higher chances of FMT in intact cats. Cultural beliefs affect the euthanasia of animals that ultimately determine how FMT patients will be handled. In the West, euthanasia of an animal whose quality of life is adversely affected is considered as an acceptable humane act, and it is often suggested to pet owners by veterinarians [21]. However, Islamic/Buddhist cultures in places like Morocco and Thailand regard the holiness of life highly, and they might refuse to resort to euthanasia due to their religious beliefs. Those owners who would not think about euthanasia might opt for even more radical medical procedures when the animal is old or even refuse to turn to the veterinarian altogether.

4. Limitations

Some other limitations of the research need to be taken into account while analyzing the results. Firstly, there is considerable heterogeneity in the datasets used by the five studies under analysis. The studies vary in terms of design (Italy – registry-based; Morocco and Brazil – prospective observational; Thailand and Korea – retrospective histopathological); sample size (the number of cases ranges from 49 feline tumors in Morocco to 683 cats in Korea) and criteria for selecting the cases (general tumor databases vs. specific to mammary lesion). Therefore, any quantitative comparisons between the studies would be misleading. In particular, the data on Italian cats is based on the Liguria regional cancer registry over 20 years [15], the dataset of Thai patients includes biopsies of a secondary care hospital in Chiang Mai between 2012 and 2019 [17], and the Brazilian data is limited only to cats with mammary lesions proven by histopathology [7].

The second limitation relates to the unequal availability of data between different countries. For instance, the Moroccan database is rather limited, and none of the five databases examined have any true national incidence data. Also, the Korean study highlights the fact that the numbers presented cannot be regarded as national incidence rates, an observation that holds true for all of the other studies.

Thirdly, FMT studies are less common than CMT studies. Dogs are widely kept as pets [22] and thus CMTs have been under greater study and discussion [23]. Therefore, few FMT studies are available, and high-quality studies even fewer.

Moreover, this review is constrained by its search approach. Using only two search engines (Edge and Google) and using a predetermined list of keywords in English may result in the omission of other papers written in other languages and available in specific veterinary databases such as CAB Abstracts or Web of Science. As a consequence, some papers might have been overlooked, causing a potential source of selection bias. For example, there may be some papers from Morocco and Thailand written in French, Arabic, or Thai language that may not appear through this type of search.

5. Conclusion

Collectively, the available evidence from studies conducted in Italy, Morocco, Brazil, Thailand, and Korea indicates that feline mammary tumors (FMTs) are highly malignant and more commonly

affect older, non-neutered female cats. Although the reported epidemiologic characteristics vary among countries, these differences are likely multifactorial and may reflect variations in neutering practice, owner education, access to veterinary care, and cultural beliefs towards preventative care or euthanasia. Many limitations of this review exist, including heterogeneity in study designs, unequal availability of data across countries, and fewer available studies compared with canine mammary tumors. Future studies using standardized study designs are needed to describe the global epidemiology of FMTs and to help us understand the regional differences.

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