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Histopathological Study of Feline Mammary Tumors in Northeastern Algeria

GABLI Zahra[1], DJERROU Zouhir[1]

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ABSTRACT

Background: This study aimed to characterize mammary lesions in domestic cats through histopathological analysis, in order to diagnose the main types of mammary tumors and evaluate their distribution.

Methods: Sixty female cats, belonging to two breeds (Siamese and crossbred) and aged between 8 and 10 years, were examined between November 2022 and November 2024 in two provinces of Northeastern Algeria (Skikda and Sétif).

Result: Clinical examination revealed mammary lesions in 30 cats (50%). Histopathological analysis identified malignant tumors in 18/60 (30%), benign tumors in 9/60 (15%) and atypical hyperplasias in 3/60 (5%). Malignant tumors were the most frequent, with several histological subtypes identified, including complex carcinoma, tubulopapillary carcinoma and squamous cell carcinoma. These findings emphasize the predominance of malignant forms in cats, the diagnostic value of histopathology and the importance of early detection and preventive measures such as early ovariectomy.

Key words: Crossbred cats, Feline mammary tumors, Histopathology, Prevalence, Siamese.

INTRODUCTION

Feline mammary tumors (FMTs) are among the most frequently diagnosed neoplasms in cats, representing nearly on third of all feline tumors (Cassali *et al*., 2025). They rank after hematopoietic and skin tumors in prevalence and are considered the most common neoplastic condition in intact female cats. Unlike canine mammary tumors, which display a broad histological heterogeneity, feline mammary tumors are less diverse but far more aggressive, with malignant carcinomas accounting for more than 80% of cases (Zhelavskyi *et al*., 2023; Nakagaki *et al*., 2021). Similar epidemiological patterns have been reported in different countries, where retrospective studies confirm their high frequency and poor prognosis (Ariyarathna *et al*., 2022; Aupperle-Lellbach *et al*., 2022).

The epidemiology of FMTs reflects several risk factors. Age is an important determinant, with the majority of cases diagnosed in cats between 9 and 11 years (Simeonov *et al*., 2023). Tumors are rare in animals under five years old and their incidence increases significantly thereafter. Hormonal influence is well established: Prolonged exposure to estrogens and progestagens strongly predisposes to mammary carcinogenesis (Laïssaoui *et al*., 2024). Preventive spaying markedly reduces the risk-cats ovariectomized before six months of age have only a 9% risk of developing mammary carcinoma compared with intact females, while those spayed after one year show little to no reduction (Pickard *et al*., 2023; Ferreira *et al*., 2024). Large-scale epidemiological studies reinforce the protective role of early spaying and highlight geographic differences in prevalence (Price *et al*., 2023).

Breed predisposition remains controversial. Some studies suggest that Siamese and domestic shorthair cats are more likely to develop mammary tumors, with Siamese cats often affected at a younger age than other breeds (Simeonov *et al*., 2023). Genetic, hormonal and environmental factors likely interact to influence susceptibility. Experimental and clinical studies in both cats and dogs underline the relevance of breed and geographic distribution in mammary tumor development (Cassali *et al*., 2020; Ariyarathna *et al*., 2022).

Histologically, feline mammary tumors are classified mainly as carcinomas of epithelial origin, including tubulopapillary, cribriform, solid and micropapillary variants (Zappulli *et al*., 2019; Zhelavskyi *et al*., 2023). Less common histotypes include lipid-rich carcinoma, mucinous carcinoma and squamous cell carcinoma. Benign tumors, though uncommon, consist of adenomas, fibroadenomas and mixed tumors, while fibroepithelial hyperplasia is frequently associated with exogenous progestagen administration (Queiroga *et al*., 2021; Torrigiani *et al*., 2022). Additional reports emphasize unusual histological subtypes such as adenomyoepitheliomas and rare variants of epithelial-myoepithelial tumors (Ali *et al*., 2021; Nunes *et al*., 2021). Recent consensus guidelines have also refined diagnostic, prognostic and therapeutic criteria, highlighting

[1]Department of Natural and Life Sciences, Faculty of Sciences, University of August 20th 1955 Skikda, Algeria.

Corresponding Author: DJERROU Zouhir, Department of Natural and Life Sciences, Faculty of Sciences, University of August 20th 1955 Skikda, Algeria. Email: zahrascom@gmail.com
ORCIDs: 0000-0002-9724-5228; 0000-0001-8329-5868

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the importance of histological pattern and molecular markers (Cassali *et al*., 2020; Cassali *et al*., 2024).

From a clinical perspective, feline mammary tumors are highly invasive and metastatic, with frequent spread to regional lymph nodes and lungs. Prognosis is generally poor and radical mastectomy is the treatment of choice (Petrucci, 2020). Prognostic markers such as necrosis quantification and staging systems have recently been proposed to improve clinical decision-making (Rodrigues-Jésus *et al*., 2024; Monteiro *et al*., 2025). Comparative oncology has also highlighted the importance of feline mammary carcinoma as a natural model of human breast cancer, given its spontaneous occurrence, aggressive nature and biological similarities (Cassali *et al*., 2025).

Despite the growing literature, regional epidemiological and histopathological data on feline mammary tumors remain limited in North Africa. Algeria, where pet ownership and veterinary care are expanding, still lacks comprehensive reports on feline mammary pathology.

The aim of the present study was therefore to describe the prevalence, histopathological features and distribution of mammary tumors in cats from Northeastern Algeria and to compare these findings with previous international reports.

MATERIALS AND METHODS

Between November 2022 and November 2024, sixty female cats (Siamese and crossbred), aged 8-10 years, were examined at the Veterinary Clinic of the Institute of Veterinary Sciences, University of Constantine. The animals originated from Skikda and Sétif provinces in Northeastern Algeria and none had undergone ovariectomy or hormonal treatment with progestagens.

All sixty cats were evaluated regardless of the presence of mammary abnormalities. Among them, only the thirty animals showing clinical mammary lesions were selected for surgical sampling and subsequent histopathological examination. Thus, the histopathological findings reported in this study pertain exclusively to these thirty lesion-positive cases.

Clinical examination

Preliminary evaluation was performed in collaboration with private veterinarians. During clinical examination, mammary masses were palpated and localized, most commonly in the caudal abdominal and inguinal glands due to their larger mammary tissue volume.

Surgical sampling

Thirty cats (50%) presented mammary lesions and underwent radical mastectomy. Excised specimens were forwarded to the Pathology Laboratory of the University Hospital of Constantine with accompanying clinical information.

Histological processing

Tissues were fixed in 10% neutral buffered formalin, embedded in paraffin, sectioned at 4 µm and stained with hematoxylin and eosin (H and E). Microscopic evaluation was carried out using the classifications of Zappulli *et al*. (2019) and Zhelavskyi *et al*. (2023).

RESULTS AND DISCUSSION

Out of the 60 cats examined, 30 (50%) presented mammary lesions confirmed by histopathology. Among these, 18 cases (30%) were malignant tumors, 9 (15%) were benign tumors and 3 (5%) were atypical hyperplasias. No significant differences in prevalence were found between Siamese and crossbred cats (P=1). The mean age of affected Siamese cats was 9±0.816 years, while crossbred cats showed a similar mean age of 9±0.187 years (Table 1). Most affected animals were between 8 and 10 years old.

Macroscopically, mammary tumors appeared as firm nodules, often ulcerated and infiltrating the caudal abdominal and inguinal glands, which represent the largest mammary complexes (Fig 1-3). Tumor masses varied in size and consistency, with some presenting as mobile, inflamed lesions and others as firm, irregular or polypoid nodules with hemorrhagic and necrotic areas.

Table 1: Distribution of the sampled feline population and its characteristics.

Province	Breed	Animals	Positive cases (%)	Age (years) Mean±SD
Skikda	Siamese	20	30 10/30 (33.33)	/
	Crossbred	15	8 8/30 (26.66)	
Setif	Siamese	15	9/30 (30)	/
	Crossbred	10	3/30 (10)	
Skikda + Setif	Siamese	19/30		Mean: 9±0.816
				8 years (6 cases)
				9 years (7 cases)
				10 years (6 cases)
	Crossbred	11/30		Mean: 9±0.187
				8 years (3 cases)
				9 years (5 cases)
				10 years (3 cases)

Microscopically, malignant epithelial carcinomas were predominant and displayed a wide histological diversity. The most frequent subtypes were complex carcinoma and tubulopapillary carcinoma (Fig 4-5). Invasive micropapillary, cribriform, comedocarcinoma and squamous cell carcinoma were also detected (Fig 9-13). Less common variants, such as lipid-rich carcinoma, adenosquamous carcinoma and papillary cystic carcinoma, were recorded in isolated cases (Fig 6-8, 14). Carcinomas with malignant myoepithelioma were observed, highlighting the heterogeneous histogenesis of feline mammary tumors (Fig 7).

Benign tumors accounted for 15% of cases and included mixed tumors with osseous and cartilaginous metaplasia (Fig 15-17). Basaloid adenoma and basaloid ductal adenoma were also identified among the benign tumors. These lesions showed typical basaloid proliferation patterns without evidence of malignant transformation. Other benign lesions consisted of complex adenomas and canalicular adenomas (Fig 18-19). The identification of osseous and cartilaginous differentiation was particularly notable given its rarity in feline species.

Hyperplastic lesions were less frequent and consisted exclusively of atypical ductal hyperplasia (Fig 20), considered a potential precursor to carcinoma.

Overall, malignant tumors represented the majority of mammary lesions, followed by benign tumors and a smaller proportion of l hyperplasia (Table 2). The histological findings emphasize both the aggressiveness and heterogeneity of feline mammary tumors in the studied population.

This study confirms the high prevalence and aggressiveness of feline mammary tumors (FMTs) in Northeastern Algeria. Half of the examined cats presented mammary lesions, with malignant carcinomas representing 60% of cases. These results are consistent with international findings, which report that 80-90% of feline mammary tumors are malignant (Zhelavskyi *et al*., 2023; Nakagaki *et al*., 2021). Similar trends of high malignancy have also been described in canine mammary tumors, where aggressive biological behavior is frequently linked to molecular alterations such as p53 overexpression (Veena *et al*., 2025), supporting the concept that mammary neoplasms across species share comparable oncogenic pathways.

The mean age of affected cats (9 years) corresponds to that described in the literature, with most cases occurring in middle-aged to older intact females (Simeonov *et al*., 2023; Pickard *et al*., 2023). Although Siamese cats have been reported to be at higher risk (Laïssaoui *et al*., 2024), our findings did not show significant breed influence. This may reflect the limited sample size or suggest that hormonal exposure and age are more important determinants than breed. Similar observations have been recorded in canine studies, where Dachshunds and other breeds develop mammary tumors primarily due to hormonal and reproductive factors rather than breed predisposition alone (Sarkar *et al*., 2022).

Histologically, carcinomas showed remarkable heterogeneity, with tubulopapillary, cribriform, micropapillary

Fig 1: Large inflamed, soft, mobile mass infiltrating the mammary chain of a siamese cat.

Fig 2: Ulcerated, firm, reddish nodular mass with irregular surface in a crossbred cat.

Fig 3: Surgical specimen showing nodular, polypoid white-yellow tissue with hemorrhagic areas.

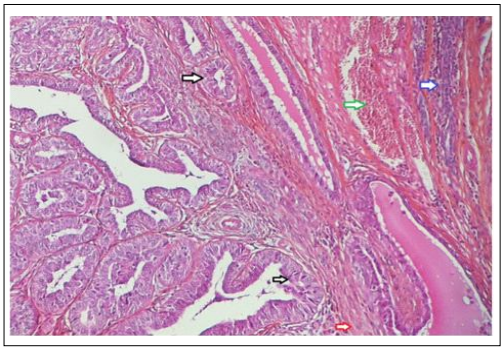


Fig 4: Complex carcinoma: Malignant epithelial tubules with benign myoepithelial component in fibrovascular stroma (H and E×10).

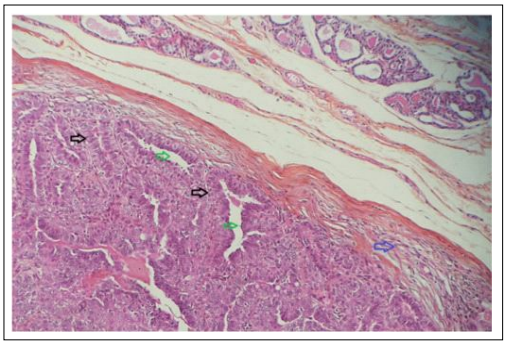


Fig 5: Tubulopapillary carcinoma: Papillary neoplastic projections supported by fibrovascular cores (H and E×10).

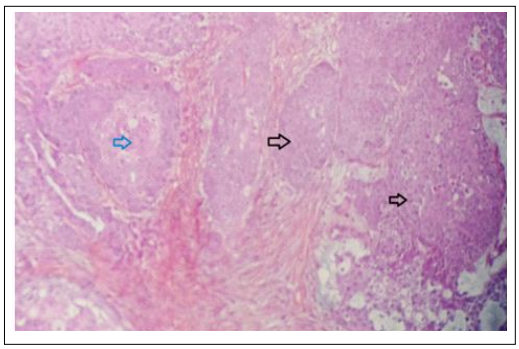


Fig 6: Adenosquamous carcinoma: Malignant epithelial cells with squamous differentiation (H and E×10).

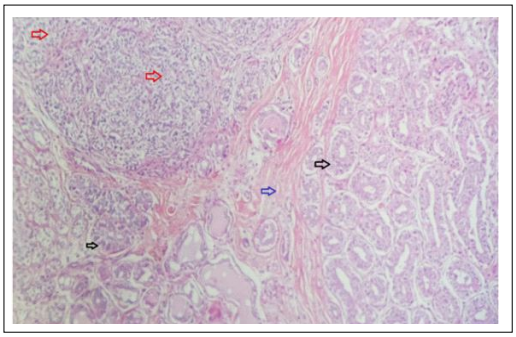


Fig 7: Carcinoma with malignant myoepithelioma: Dual malignant epithelial and myoepithelial populations (H and E×10).

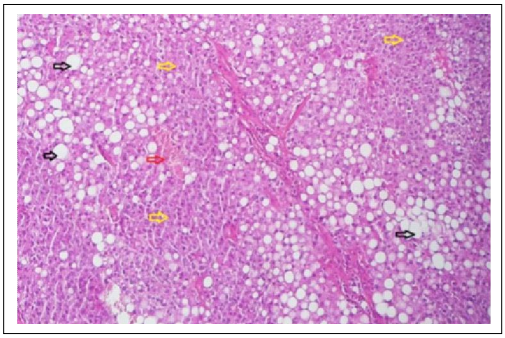


Fig 8: Lipid-rich carcinoma: Neoplastic cells with vacuolated cytoplasm and focal necrosis (H and E×10).

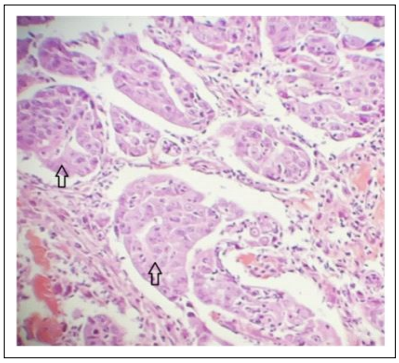


Fig 9: Invasive micropapillary carcinoma: Intraluminal papillary clusters lacking stromal support (H and E×10).

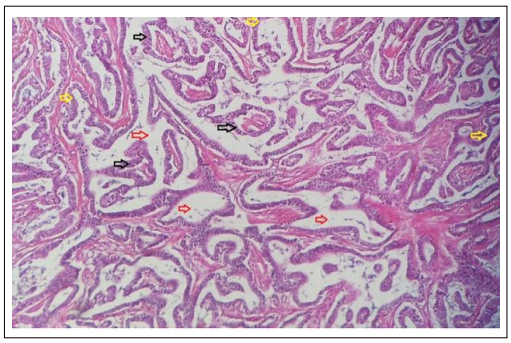


Fig 10: Micropapillary carcinoma: Irregular intraductal papillary clusters surrounded by empty spaces (H and E×10).

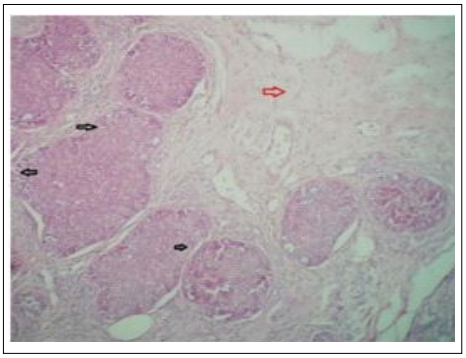


Fig 11: Cribriform carcinoma: Sieve-like arrangement of polygonal neoplastic cells (H and E×10).

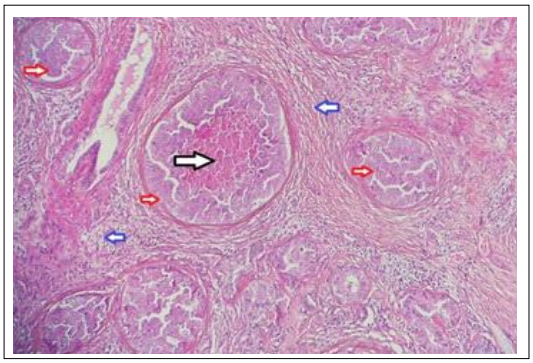


Fig 12: Comedocarcinoma: Central necrosis within nests of neoplastic cells (H and E×10).

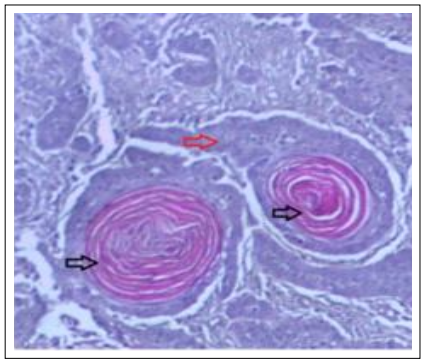


Fig 13: Squamous cell carcinoma: Epithelial cords with keratin pearl formation (H and E×10).

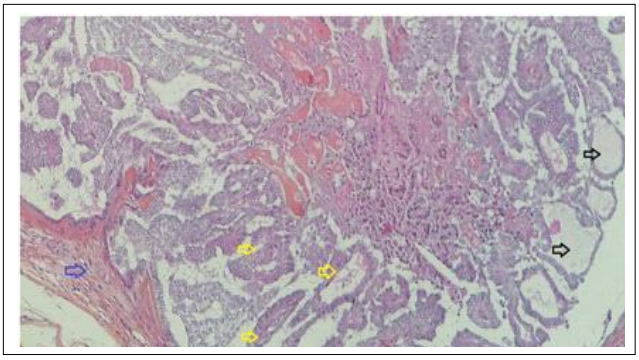


Fig 14 : Papillary cystic carcinoma: Papillary projections extending into dilated cystic lumina (H and E×10).

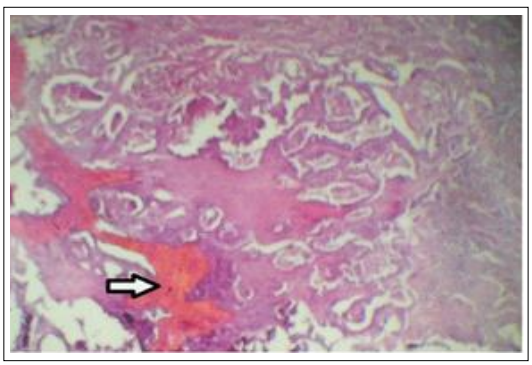


Fig 15: Benign mixed tumor with osseous metaplasia (H and E×10).

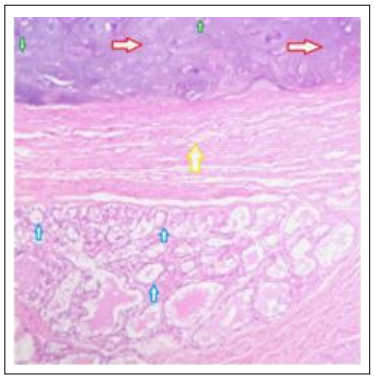


Fig 16: Benign mixed tumor with cartilaginous metaplasia (H and E×10).

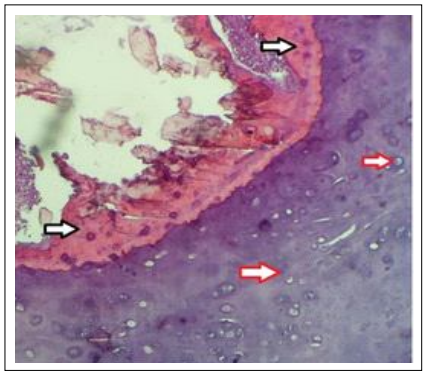
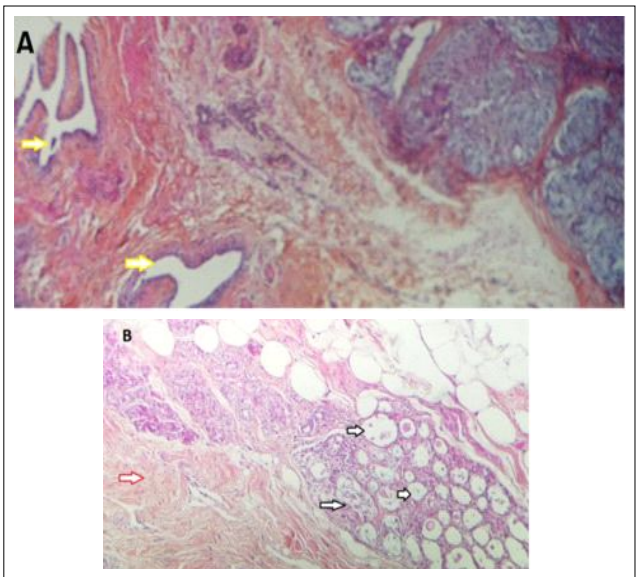


Fig 17: Benign mixed tumor with combined osseous and cartilaginous metaplasia (H and E×10).



(A) Myoepithelial cells are spindle-shaped to stellate (yellow arrow), with stromal tissue present (red arrow). (B) Foci of myoepithelial cell proliferation are observed adjacent to several ducts (black arrow) (H and E×10).

Fig 18: Complex adenoma: Myoepithelial proliferation adjacent to ducts in fibrous stroma.

and squamous cell carcinomas predominating. Complex carcinomas and comedocarcinomas were also observed. Less common variants such as lipid-rich and papillary cystic carcinoma, although rare, were identified, confirming the wide morphological spectrum of FMTs (Geovanni *et al*., 2025). Benign lesions such as complex adenomas and canalicular adenomas were rare, as expected in feline species (Queiroga *et al*., 2021). The presence of stromal remodeling in some tumors may resemble findings in other species, where proteolytic enzymes like MMP-11 (stromelysin-3) have been shown to contribute to invasive behavior (Sahoo *et al*., 2015), further reinforcing the aggressive histological nature of mammary carcinomas.

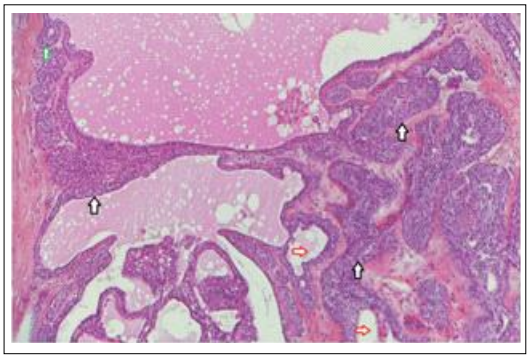


Fig 19: Canalicular adenoma: Bicellular cords with luminal and basal layers forming slit-like lumina (H and E×10).

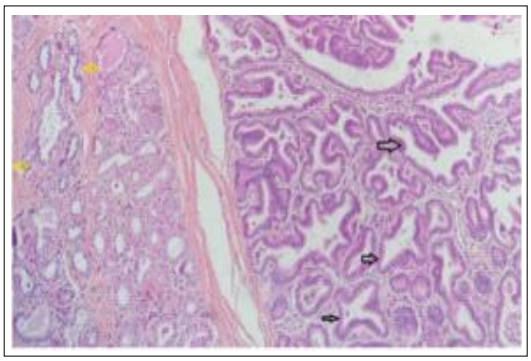


Fig 20: Atypical ductal hyperplasia: Intralobular ductal proliferation with epithelial atypia (H and E×10).

The detection of mixed tumors with osseous and cartilaginous metaplasia in this study is noteworthy. Although uncommon in cats, such tumors have been recently described (Monteiro *et al*., 2025). Their occurrence suggests the capacity of feline mammary epithelial and myoepithelial cells to undergo metaplastic transformation, resembling some canine and human breast lesions. Such plasticity has also been observed in canine tumors undergoing multiphenotypic differentiation during progression (Sarkar *et al*., 2022).

The observation of atypical ductal hyperplasia highlights the continuum between non-neoplastic proliferative lesions and carcinoma. Such lesions are considered preneoplastic and carry a significant risk of malignant transformation (Pickard *et al*., 2023; Souza *et al*., 2024). Their identification underlines the importance of systematic histological examination, even in small nodules, to establish an accurate prognosis. Molecular studies in rodent mammary tumor models have shown that early proliferative changes often coincide with altered gene expression stability (Arora *et al*., 2021), suggesting potential for future molecular characterization in feline lesions as well.

From a comparative oncology perspective, feline mammary carcinoma shares several biological features with human breast cancer, including its spontaneous development, hormonal influence, histological diversity and aggressive clinical behavior. This supports the use of the cat as a relevant model for translational breast cancer research (Geovanni *et al*., 2025). Furthermore, therapeutic

Table 2: Percentage of mammary lesions according to tumor types.

Number of recorded cats	Tumor type	Histological types of mammary lesions	Percentage (%)	
9/60	Benign tumors	Benign mixed tumors	3/9 (15.78)	15
		Complex adenomas	1/9 (11.11)	
		Basaloid adenoma	4/9 (44.44)	
		Basaloid ductal adenoma	1/9 (11.11)	
18/60	Malignant tumors	Complex carcinoma	2/18 (11.11)	30
		Tubulopapillary carcinoma	2/18 (11.11)	
		Comedocarcinoma	1/18 (5.55)	
		Adenosquamous carcinoma	2/18 (11.11)	
		Carcinoma and malignant myoepithelioma	3/18 (16.66)	
		Lipid-rich carcinoma	1/18 (5.55)	
		Invasive micropapillary carcinoma	1/18 (5.55)	
		Squamous cell carcinoma	2/18 (11.11)	
		Papillary cystic carcinoma	2/18 (11.11)	
		Cribriform carcinoma	1/18 (5.55)	
3/60	Atypical hyperplasia	Atypical ductal hyperplasia		5

advances in other species-such as low-dose metronomic chemotherapy shown to be beneficial in canine mammary tumors (Sowbharenya *et al*., 2018) -may provide alternative avenues for future investigation in feline oncology.

In Algeria, the increasing popularity of companion animals and the establishment of specialized veterinary services provide opportunities to improve early detection and treatment. However, awareness among owners and veterinarians remains essential, as delayed presentation and diagnosis may compromise outcomes. Radical mastectomy remains the recommended treatment, as conservative excision is usually followed by recurrence. Preventive ovariectomy before the first estrus remains the most effective strategy for reducing the risk of mammary tumors (Ferreira *et al*., 2024).

CONCLUSION

Feline mammary tumors in Northeastern Algeria were highly prevalent and predominantly malignant. The majority were invasive carcinomas with aggressive histological patterns, while benign tumors and atypical hyperplasias were less common. These findings emphasize the need for early diagnosis and systematic histopathological evaluation to guide treatment and prognosis. Radical mastectomy should be considered the standard therapeutic approach and preventive spaying before the first estrus remains the most efficient method to reduce the risk of mammary tumors in cats. Beyond clinical relevance, the biological similarities between feline mammary carcinoma and human breast cancer reinforce its role as a valuable comparative model in oncology.

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Disclaimers

The views and conclusions expressed in this article are solely those of the authors and do not necessarily represent the views of their affiliated institutions. The authors are responsible for the accuracy and completeness of the information provided, but do not accept any liability for any direct or indirect losses resulting from the use of this content.

Informed consent

All animal procedures for experiments were approved by the Committee of Experimental Animal Care and Handling Techniques were approved by the University of Animal Care Committee.

Conflict of interest

The authors declare that there are no conflicts of interest regarding the publication of this article. No funding or sponsorship influenced the design of the study, data collection, analysis, decision to publish, or preparation of the manuscript.

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