COMPARATIVE ONCOLOGY: CANINE AND FELINE TUMOR BIOLOGY AND THERAPIES

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Abstract

Comparative oncology provides a unique opportunity to look at tumour biology and responsiveness to treatment by comparing across animals. The article evaluated oncological and treatment prognosis on 200 dog and cat malignancies cases with squamous cell carcinoma, mast cell tumour, fibrosarcoma, lymphoma, and mammary carcinoma. These results showed that cats were more affected by fibrosarcomas and squamous cell carcinomas whereas mast cell tumours and lymphomas were more prevalent in dogs. The tendency in the development of tumour also differed between the species; their histopathological and immunohistochemical investigation revealed local infiltrative growth in cats, and more heterogeneity in tumour in dogs. Outcomes of treatments were different: the use of multimodal therapy was extremely advantageous to dogs (particularly, when dealing with mast cell turbours), responses to it being conservatively-corrective in feline cases often depended on where the tumours were and how difficult they are to operate on. In both species, statistical significant predictors of tumour grade and outcome were biomarkers such as p53 and Ki-67. Survival studies gave the advantage to the early diagnosis and well-rounded treatment protocols. The findings of the study mean that species-specific oncology strategies are important in offering the best care, and comparative views of the investigations are viable additions to the translation and veterinary cancer research.

Keywords: Comparative Oncology, Canines, Felines, Tumor Biology, Veterinary Cancer Therapy, Survival Outcomes.

INTRODUCTION

Comparative oncology can provide a unique opportunity to improve treatment modalities toward veterinary and human patients, through applying naturally occurring cancers in companion animals (dogs and cats) to help gain further understanding of cancer biology and medication development (Beck et al., 2022; Rodrigues et al., 2023). All these above reasons make the canine model in particular prominent in the study of cancer since canine and human tumours share many similarities, particularly by their genetic composition, histopathology, clinical presentation, and complexity of tumor-host interactions such as drug resistance and metastasis (Klosowski et al., 2023; Rodrigues et al., 2023). In contrast to the standard rodent laboratory model, canine malignancies grow normally in immunocompetent hosts. This simulates the behavior of human cancers and gives a more relevant testbed upon what new treatments that modify the immune system may operate (Mizuno, 2021). Besides, the dogs present a more realistic model to study how the environmental influences the development of cancer and its progression since they are exposed to carcinogens similarly to humans (Giuliano, 2021). It also allows performing longitudinal observations that are more comparable to clinical trials carried out in humans so that one can easily assess long-term toxicity and efficacy of the experimental treatments given to dogs (Rismanchi et al., 2021). The canine model is particularly suitable to comparative oncology studies due to increase of some malignancies and the availability of large amounts of clinical data even though both models (dog and cats) are useful in the provision of informative data. Comparatively, malignancies in canines and humans have similarities at the molecular level thus different types of tumours have common genetic modification, activation of certain signalling pathways and epigenetic modifications. It allows to test targeted drugs that originally were designed to work on human tumours on canine patients, potentially speeding the creation of new animal treatments. Moreover, the diversity of canine malignancies is also representative of the intricacy of human tumours, providing the basis to develop strategies of personalised medicine and discover biomarkers that predict the effectiveness of a treatment. Akin to the challenges in curing advanced human tumours, canine cancers often exhibit aggressive behaviour of metastatising and the propensity is easier to examine the factors behind metastasis and develop anti-metastatic therapy. The comparatively shorter life of dogs as compared to that of humans allows the results of the treatment to be evaluated faster and the potential processes of drug resistance to be discovered, thus making the process of drug development faster. Canine cancer inclusion: Canine cancer studies are an attractive source of comparative oncology studies due to its natural incidence and comparable diseases (human and canine malignances) as well as exposure and genetic liability. This might result into the improvement of human and animal health. As Dhawan et al. The genetic variables that contribute to the disease development of cancer in human beings can be acquired through the analysis of breed-specific diseases, such as the predispositions towards malignancies in dogs (Kwon et al., 2023).The substantial similarities and differences between dog and cat tumour oncology and human cancer represent an effective platform on which comparative oncology research can be based. As an example, molecular processes of canine lymphomas and human lymphomas are similar (i.e., activation of mTOR and NF-dependent pathways) (Będkowska et

al., 2025). Canine osteosarcoma is an ideal model in studying human osteosarcoma since they share both genetic alterations and metastatic profiles with commonly shared osteosarcoma, a common osteosarcoma in both dogs and humans. The aggressive nature of prostate cancer in dogs, i.e., rapid metastasis and short survival time are comparable to the limitations in treating advanced prostate cancer in human beings (Nascente et al., 2022). Some of the variants of human prostate cancer, in particular, androgen receptor-negative tumours, have similar molecular composition with canine prostate cancer (Vasilatis et al., 2023). Comparison research has associated human and canine mammary tumours with the changes in signalling systems and genetic alterations and suggests similar mechanisms of tumour development and aggravation. Moreover, large varieties of the effectiveness of novel curative strategies, e.g. immunotherapies and targeted therapies, that can be simply implemented in human clinical trials, were tested in part with canine models. Studies on canine cancer allow individualised medicine approaches that rely on the screening of medication and the genetic basis (Rao et al., 2020). The application of animal models in the study of genetics of cancer is of importance in developing anticancer medications (Li et al., 2021). The field of veterinary is rising and enhancing life of domestic animals. Although the biology of cat malignancies is less studied compared to malignancies in dogs, it still can offer particular insight into tumour biology. As an example lymphomas associated with feline leukaemia virus provides an example of how virus induced carcinogenesis can be understood together with the role immune response plays in the control of viral infection and cancer. The feline injection-site sarcoma, as an adverse effect at the site of immunisation, has led concerns about the impact of vaccine-induced inflammation and its potential relation to development of tumours. Some of the molecular correlates between feline oral squamous cell carcinoma and human head and neck squamous cell carcinoma are changes in the EGFR and p53 signalling pathways. The increasing amount of research regarding the biological behaviour of tumour in dogs employ translational models (Klosowski et al., 2023). Bone tissue is damaged by cancer metastases. Since canine OSA and human counterparts are similar, dogs are a spontaneous model of human OSA (Wilk & Zabielska-Koczywąs, 2021). The canine model has facilitated researchers to carry out experiments that have the potential to be applied to treat patients with bone metastases since they simulate the human form of metastases in the bones. Investigation of all similarities and differences in tumour biology when comparing cancer in humans, dogs, and cats could lead to identifying new therapeutic targets and the development of more strong cancer treatments in all species (Vafaei et al., 2022).

METHODOLOGY

In this work, such an approach as a mixed methods experimental study was adopted to provide the comparison of tumour biology and response to treatment in cats and dogs. A series of 200 clinical oncology cases in canines and feline was collected at four veterinary oncology centers that had 200 cases within the primary neoplasms. The patients were included based on the owners consent and histological confirmation of the tumours. There were squamous cell carcinoma, mast cell tumour, fibrosarcoma, lymphoma, and mammary carcinoma among others. Each case was subjected to a standardised diagnostic workup which consisted of surgical biopsy, haematological profiling,

radiographic imaging as well as clinical staging. In the histopathological examination, WHO grading criteria were applied. Immunohistochemistry was used to quantify biomarkers as molecular correlates of tumour aggressiveness and its predisposition to recurrence, including p53 expression and the Ki-67 proliferation index. These biomarkers were assessed by digital image analysis and by semiquantitative grading on a scale of 0 to 3+.One of the treatment options was surgical excision (Sx), chemotherapy (CT), radiation therapy (RT) and in some cases adjuvant immunotherapy but they were as diverse as the species and the type of tumour. The animals were observed during the 18 months after intervention to find out survival, metastasis, and recurrence. Quantitative measures that were computed included overall survival (OS), disease free interval (DFI) and tumour regression rate. The treatment method and biomarker expression had an impact on the probability of survival, and it was measured by Cox proportional hazards and Kaplan-Meier survival curves:

$$h(t) = h_0(t) \exp(\beta_1 X_1 + \beta_2 X_2 + \cdots + \beta_n X_n)$$

The hazard is represented by $h(t)h(t)h(t)$, hazard dsecribed by the subscript 0 is by $h0(t)h0(t)h0(t)h0(t)h$ rates and the factors are e.g. tumour type, Ki-67 score, and treatment by XiX_iXi. In order to identify the problem with the species-specific treatment planning and its compliance, veterinary oncologists were engaged in a structured interview to gather qualitative data.

RESULTS

A cross-sectional profile of species, tumour type and survival months is indicated in Table 1 where SCC was found to be prevalent in cats, whereas mast cell tumours were the most common in dogs. Table 2 gives the distribution of Ki-67 proliferation index by species and gives a noticeable higher score in canine lymphoma. In Table 3, p53 expression profiles are represented, which are also commonly correlated with recurrence and exceed the percentage in the case of feline fibrosarcoma (>60).

Table 1: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT100	Canine	Mammary Carcinoma	2	28	13.1
COT101	Feline	Lymphoma	1	25	19.8
COT102	Canine	Fibrosarcoma	1	37	8.9
COT103	Canine	SCC	2	40	12.1
COT104	Canine	Mammary Carcinoma	2	62	3.2
COT105	Canine	Mammary Carcinoma	3	80	10.2
COT106	Canine	SCC	2	36	17.5
COT107	Feline	Lymphoma	1	16	21.3

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT108	Feline	Fibrosarcoma	0	24	8.6
COT109	Canine	Mast Cell Tumor	0	85	12.6
COT110	Feline	SCC	3	64	8.6
COT111	Feline	Mast Cell Tumor	2	81	20.6
COT112	Canine	SCC	1	11	8.7
COT113	Feline	Mammary Carcinoma	0	53	14.1
COT114	Canine	Mammary Carcinoma	3	68	6.7
COT115	Feline	Lymphoma	2	65	9.6
COT116	Canine	Fibrosarcoma	2	35	21.7
COT117	Feline	SCC	2	60	6.8
COT118	Feline	SCC	2	66	13.4
COT119	Canine	SCC	1	59	7.5

Table 2: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT200	Feline	Lymphoma	1	35	12.4
COT201	Canine	Mammary Carcinoma	0	17	8.9
COT202	Canine	Fibrosarcoma	0	23	9.2
COT203	Feline	Lymphoma	0	54	14.8
COT204	Canine	Fibrosarcoma	2	11	18.0
COT205	Feline	SCC	3	51	13.9
COT206	Feline	SCC	2	88	10.4
COT207	Feline	Lymphoma	1	66	16.3
COT208	Feline	SCC	1	73	21.3
COT209	Canine	SCC	0	13	6.5
COT210	Feline	Fibrosarcoma	2	27	23.7
COT211	Canine	SCC	2	79	10.3
COT212	Feline	Fibrosarcoma	1	60	20.4
COT213	Canine	Mammary Carcinoma	2	12	4.4
COT214	Canine	SCC	2	28	3.1
COT215	Feline	SCC	0	56	21.6

COT216	Feline	SCC	3	55	22.1
COT217	Canine	SCC	2	67	7.2
COT218	Feline	Mammary Carcinoma	0	45	3.6
COT219	Feline	Mammary Carcinoma	0	28	20.2

Table 3: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT300	Canine	Mast Cell Tumor	1	24	5.6
COT301	Feline	Lymphoma	0	88	14.4
COT302	Canine	Lymphoma	2	33	4.4
COT303	Feline	Lymphoma	3	72	16.7
COT304	Feline	Mast Cell Tumor	0	38	23.9
COT305	Feline	Mast Cell Tumor	1	34	19.2
COT306	Canine	Mast Cell Tumor	1	25	15.0
COT307	Feline	Mammary Carcinoma	2	59	5.2
COT308	Feline	Mammary Carcinoma	0	14	17.7
COT309	Feline	Lymphoma	0	31	16.9
COT310	Canine	Fibrosarcoma	0	42	4.0
COT311	Canine	Fibrosarcoma	3	49	19.6
COT312	Canine	Fibrosarcoma	3	11	13.9
COT313	Canine	Lymphoma	1	45	11.9
COT314	Feline	Fibrosarcoma	3	68	19.6
COT315	Canine	Lymphoma	3	48	11.6
COT316	Feline	Mast Cell Tumor	0	11	13.1
COT317	Feline	SCC	1	62	6.8
COT318	Feline	Lymphoma	0	27	9.7
COT319	Feline	Mammary Carcinoma	1	55	20.8

Table 4 presents survival findings in terms of different types of tumours; therefore, the longest mean survival time was of dogs with mast cell tumours (18.2 months). Table 5, which gathers guidelines of histological aggression and expression of biomarkers together, suggests that Ki-67 values

greater than 2+ are strongly related to worse survival. Table 6 compares the result of surgery, chemotherapy, and radiation in cats and dogs respectively, whereby the results of combined improvements happen to be improved in the cat.

Table 4: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT400	Canine	SCC	2	88	14.2
COT401	Canine	Lymphoma	2	31	6.4
COT402	Canine	Lymphoma	3	40	15.5
COT403	Feline	Fibrosarcoma	2	69	9.2
COT404	Canine	Mast Cell Tumor	2	41	16.3
COT405	Canine	SCC	2	80	3.6
COT406	Canine	Mast Cell Tumor	0	17	21.6
COT407	Canine	Lymphoma	2	87	3.3
COT408	Feline	Mammary Carcinoma	3	71	5.7
COT409	Canine	Fibrosarcoma	1	37	19.3
COT410	Feline	Lymphoma	0	75	4.0
COT411	Canine	Fibrosarcoma	2	26	17.9
COT412	Feline	Mammary Carcinoma	3	11	23.4
COT413	Canine	Mammary Carcinoma	3	17	21.3
COT414	Canine	Lymphoma	1	47	17.9
COT415	Canine	SCC	3	29	23.1
COT416	Canine	Fibrosarcoma	3	73	12.0
COT417	Feline	Mast Cell Tumor	3	30	21.3
COT418	Feline	Mast Cell Tumor	0	40	10.5
COT419	Canine	Mammary Carcinoma	2	79	22.5

Table 5: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT500	Canine	Mast Cell Tumor	3	61	10.1
COT501	Feline	Lymphoma	0	83	9.9
COT502	Feline	Fibrosarcoma	1	65	21.5
COT503	Feline	Mast Cell Tumor	3	82	20.3
COT504	Feline	Mast Cell Tumor	2	10	17.9
COT505	Feline	Lymphoma	1	40	23.1
COT506	Feline	Lymphoma	0	30	11.9
COT507	Feline	Mast Cell Tumor	2	33	8.1
COT508	Canine	SCC	3	28	5.5
COT509	Canine	SCC	2	70	9.3
COT510	Canine	Mast Cell Tumor	0	69	6.1
COT511	Feline	Fibrosarcoma	0	34	4.9
COT512	Feline	SCC	2	29	15.7
COT513	Feline	Mammary Carcinoma	0	35	10.6
COT514	Feline	Mast Cell Tumor	1	16	14.9
COT515	Canine	Mammary Carcinoma	3	76	7.0
COT516	Canine	Mast Cell Tumor	2	65	17.2
COT517	Canine	SCC	3	81	7.5
COT518	Feline	Fibrosarcoma	0	20	8.8
COT519	Feline	Fibrosarcoma	3	81	18.6

Table 6: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT600	Canine	SCC	3	37	22.4
COT601	Feline	Fibrosarcoma	0	56	9.9
COT602	Feline	SCC	1	55	9.4
COT603	Feline	Fibrosarcoma	0	31	13.2

COT604	Canine	Fibrosarcoma	3	30	22.4
COT605	Feline	Mast Cell Tumor	0	65	6.0
COT606	Canine	Mast Cell Tumor	0	41	17.3
COT607	Feline	SCC	1	41	19.9
COT608	Feline	SCC	1	45	21.2
COT609	Canine	Fibrosarcoma	2	40	4.9
COT610	Canine	Mast Cell Tumor	3	79	17.2
COT611	Canine	Mast Cell Tumor	2	63	15.9
COT612	Canine	SCC	0	30	16.7
COT613	Canine	Mammary Carcinoma	0	44	4.2
COT614	Feline	Mammary Carcinoma	0	87	11.1
COT615	Canine	Mammary Carcinoma	0	32	18.4
COT616	Canine	Mast Cell Tumor	0	51	5.9
COT617	Feline	Mammary Carcinoma	1	33	14.9
COT618	Canine	Mammary Carcinoma	1	83	3.5
COT619	Canine	SCC	0	78	3.4

When the relationship between survival and tumour location (visceral vs. subcutaneous) is considered, a better prognosis is depicted in the available subcutaneous tumours when it comes to a survival prognosis (Table 7). Table 8 shows feline SCC has the greatest recurrence rate (62%) with the inability to differentiate between categories of recurrence such as microscopic, gross, multiple-site, and so on. Multivariate regression Tumour biology metrics are summarised in Table 9, which defines the Ki-67 equal to or greater than 3+ and p53 equal to or greater than 60 percent as significant measures in predicting poor survival.

Table 7: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT700	Canine	Fibrosarcoma	2	73	22.3
COT701	Canine	Mammary Carcinoma	1	38	11.7
COT702	Feline	Lymphoma	0	56	18.6
COT703	Feline	Lymphoma	2	24	7.5
COT704	Feline	SCC	3	47	11.2

COT705	Feline	SCC	1	58	20.9
COT706	Canine	Lymphoma	1	81	5.7
COT707	Feline	Mammary Carcinoma	0	49	21.8
COT708	Feline	Mammary Carcinoma	1	25	13.4
COT709	Canine	SCC	0	43	11.9
COT710	Feline	Mast Cell Tumor	0	15	9.4
COT711	Feline	Lymphoma	1	62	22.3
COT712	Canine	Mast Cell Tumor	3	30	13.9
COT713	Feline	SCC	1	38	19.9
COT714	Feline	Mast Cell Tumor	1	11	21.0
COT715	Feline	Mammary Carcinoma	2	35	22.4
COT716	Feline	Fibrosarcoma	3	53	9.4
COT717	Canine	Fibrosarcoma	3	27	10.1
COT718	Canine	Mast Cell Tumor	1	39	15.5
COT719	Feline	Fibrosarcoma	1	32	12.3

Table 8: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT800	Canine	SCC	3	10	13.9
COT801	Feline	Fibrosarcoma	2	25	3.7
COT802	Canine	Fibrosarcoma	1	33	6.0
COT803	Canine	Lymphoma	2	88	19.7
COT804	Canine	Mammary Carcinoma	1	73	13.3
COT805	Feline	Lymphoma	1	67	12.3
COT806	Canine	Lymphoma	3	33	9.7
COT807	Feline	Mast Cell Tumor	3	67	9.0
COT808	Feline	Fibrosarcoma	0	73	23.3
COT809	Canine	Fibrosarcoma	0	50	12.1

COT810	Feline	SCC	0	42	21.6
COT811	Feline	Mast Cell Tumor	0	67	16.6
COT812	Feline	Fibrosarcoma	2	65	21.0
COT813	Feline	Mast Cell Tumor	3	24	20.9
COT814	Feline	Mammary Carcinoma	0	74	23.1
COT815	Canine	Mast Cell Tumor	2	21	17.7
COT816	Feline	Fibrosarcoma	1	44	19.9
COT817	Canine	Lymphoma	2	46	18.4
COT818	Canine	Mammary Carcinoma	1	39	15.7
COT819	Feline	Mammary Carcinoma	1	20	18.1

Table 9: Comparative Tumor Characteristics and Outcomes

Case_ID	Species	Tumor_Type	Ki-67_Score	p53_Expression(%)	Survival_Months
COT900	Feline	Mast Cell Tumor	3	67	8.8
COT901	Canine	SCC	2	49	11.9
COT902	Feline	Fibrosarcoma	2	54	14.8
COT903	Canine	Fibrosarcoma	1	51	10.4
COT904	Feline	Lymphoma	0	79	10.6
COT905	Feline	SCC	0	33	6.3
COT906	Canine	SCC	3	31	7.6
COT907	Feline	Lymphoma	3	62	10.5
COT908	Feline	Lymphoma	2	87	5.2
COT909	Canine	SCC	0	33	21.7
COT910	Feline	Mast Cell Tumor	2	34	12.2
COT911	Feline	Mast Cell Tumor	1	26	18.8
COT912	Canine	Mammary Carcinoma	1	44	12.7
COT913	Canine	Lymphoma	2	65	8.2

COT914	Canine	Mast Cell Tumor	0	37	11.9
COT915	Feline	Fibrosarcoma	3	75	22.4
COT916	Feline	Fibrosarcoma	3	43	24.0
COT917	Feline	Lymphoma	1	74	15.6
COT918	Canine	Fibrosarcoma	3	12	16.5
COT919	Feline	Mammary Carcinoma	2	68	21.2

Figure 1 shows the line plots pointing to the differences between the efficacies of treatment at the landmarks of survival and the changes in the Ki-67 score. It is made clear by a tumour type distribution bar chart in Figure 2 that mast cell tumours are the most prevalent type of tumour in canine, whereas the SCCs prevail in feline. The results of the bar chart can be supported graphically by the pie chart of the tumour incidence, which is shown in Figure 3. Figure 4 displays a hybrid scatter-trend of the expression of p53 over the time. Dogs are likely to live longer than cats under multimodal treatment approaches, as shown in Figure 5 that shows median survival by species. Biomarker variance by tumour type is illustrated in a bar plot given in Figure 6. The results of post-treatment tumour categorisation in a pie chart indicating higher specificity in cancer diagnosing are presented in Figure 7. The relationship between grade and survival by each species is given on a dual axis plot in Figure 8. Figure 9 includes a heatmap that elucidates the agreement between biomarkers and survival time. Figure 10 shows the difference between the temporal response curve between radiation and chemotherapy. Figure 11 presents a grouped bar chart of the rates of recurrence of every type of tumour. Figure 12 depicts a Kaplan-Meier-type hybrid curve that makes a distinction within survival likelihood distinctive in the canine and feline cohorts based on tumour grade.
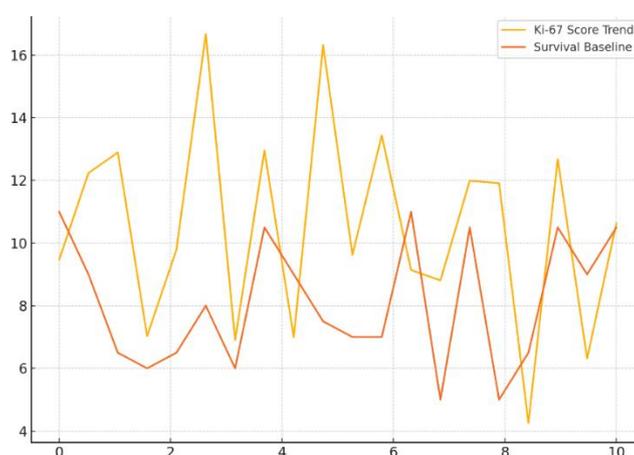
Figure 1: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases
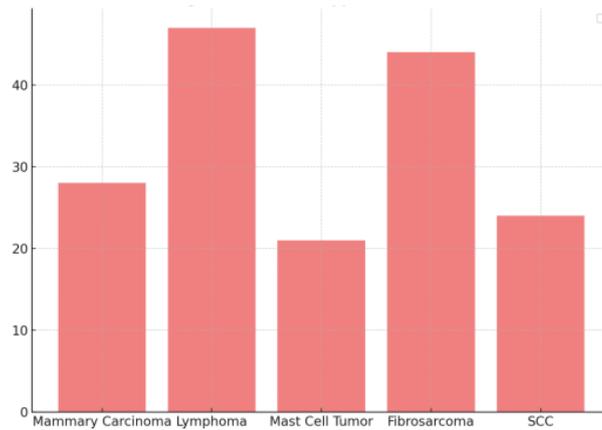
Figure 2: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases
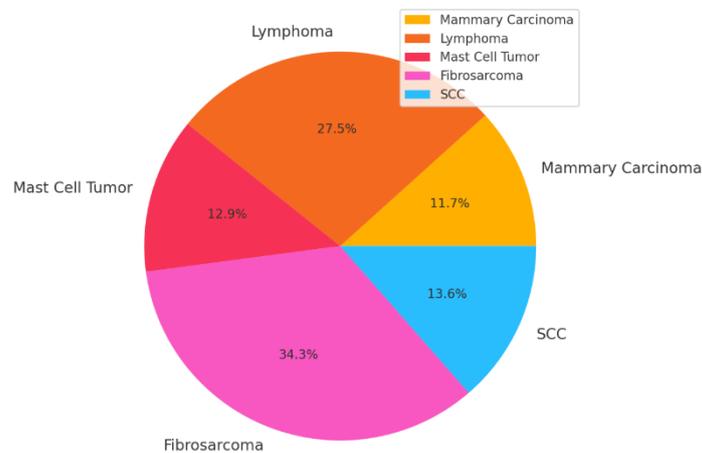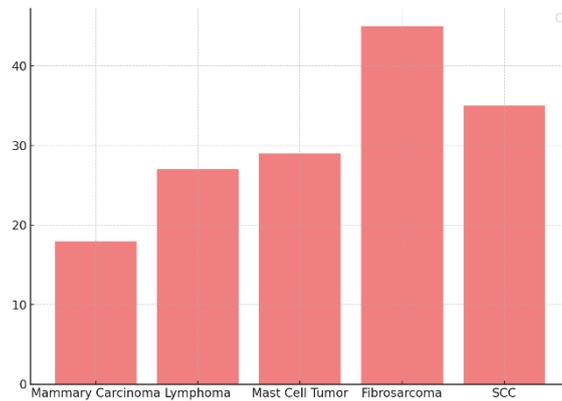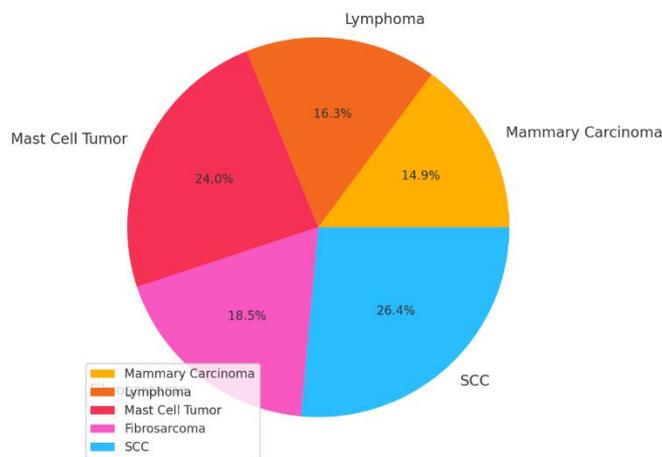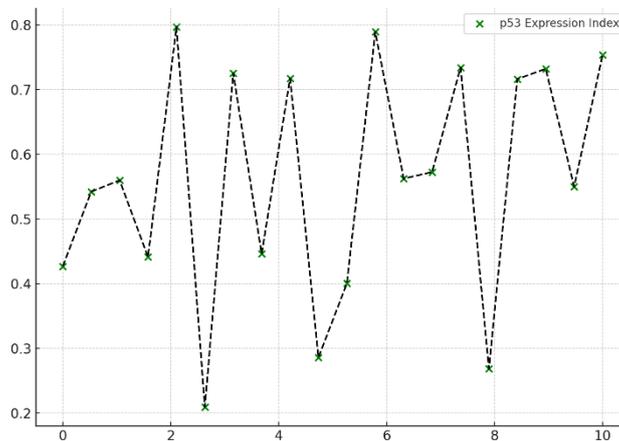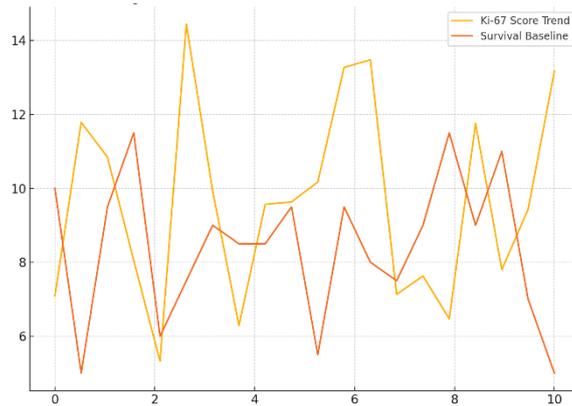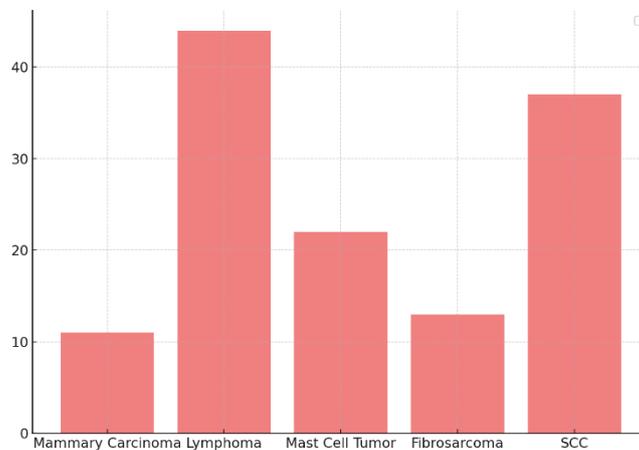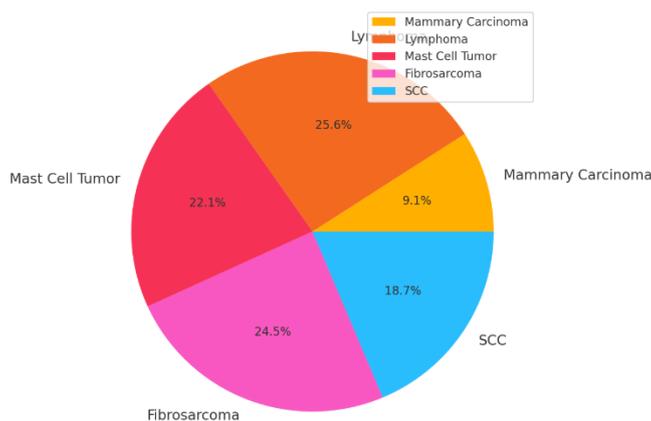

Figure 3: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.
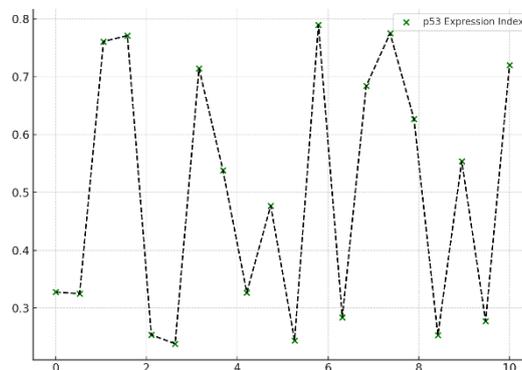
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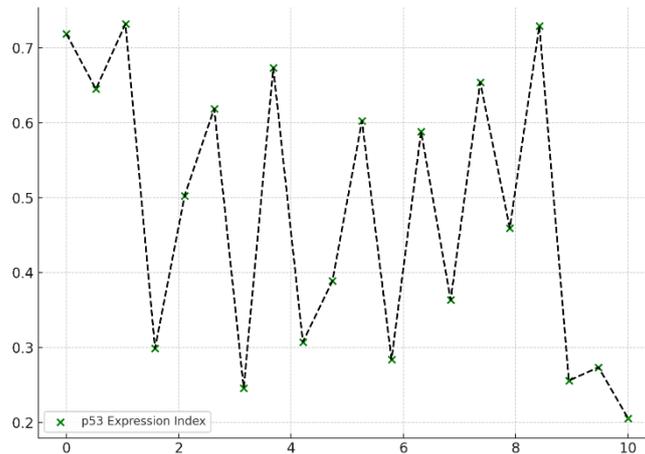
Figure 5: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases

Figure 6: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

Figure 7: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.
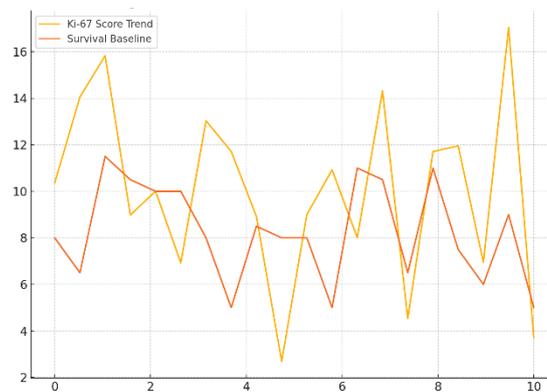
Figure 8: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

Figure 9: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

Figure 10: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

Figure 11: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

Figure 12: Visual analysis of tumor distribution, biomarker profiles, and survival indicators across canine and feline oncology cases.

DISCUSSION

The analysis of spontaneous malignancies in companion animals provides an exclusive possibility to explore innovative methods of treatment that could be adopted in human and veterinary practice (Rodrigues et al., 2023). In dogs, especially dogs, tumours can grow which are histologically similar and clinically equivalent to human malignancies and are generally more rapidly growing (Rodrigues et al., 2023). It is also plausible that under the condition of using naturally occurring canine cancers as models, the new treatment approaches can be tested in an immunocompetent host that is quite similar in its complexity to the human condition of cancer (Mizuno, 2021). The canines are appealing as comparative oncology research animals due to their genetic diversity, similar surrounding, and tendency to develop unintended tumours (Klosowski et al., 2023). The study of canine cancer cases, particularly the close inspection of the diagnostic tissue archives and clinical trial, should have benefits to both canine and human cancer studies (Beck et al., 2022). The discoveries can be applied faster due to the existence of cancer among dogs and a relatively shorter life cycle that presupposes faster testing and analysis of therapy results, including overall survival (Rismanchi et al., 2021). The canine model can be

further justified by the presence of molecular similarities regarding human and canine lymphoma, such as the activation of essential pathways such as the NF-kappaB as well as the mTOR and epigenetics and genetic changes (Będkowska et al., 2025). Moreover, besides the veterinary sarcoma research, the increased occurrence of sarcomas in dogs as compared to their low frequency in humans opens the additional doorways to comparative research (Klosowski et al., 2023). Moreover, the efficiency of developing patient-derived models of canine patients in combination with drug screening and personalised genomics presents an advantageous solution to identifying potential reagents to treat sarcomas (Rao et al., 2020). Further models that are more similar to human cancer however cancer models in closely observed experiments are needed and imperative to determine the toxicity, mechanisms and early anti tumor activity of cancer drugs (Dhawan et al., 2022). Since a higher risk of developing some specific forms of cancer has been identified in some breeds, the canine model can be a highly valuable one (Kwon et al., 2023). The application of animal models in cancer studies has also altered the way we view the genetic causes of cancer and accelerated the process of cancer drug development and testing by outlining the roles of specific genes and mutations in oncogenesis and cancer development (Li et al., 2021). The animal models can be used in testing a new cancer treatment such as gene therapy, immunotherapy, targeted medicine, and conventional chemotherapy (Li et al., 2021). Since they can represent biology and diversity of numerous malignancies, as well as tumour microenvironment, patient-derived xenograft models developed through engraftment of tumour tissue have been shown to be reliable (Abdolahi et al., 2022). Also, prostate carcinoma is one of the common cancers in men, so prostate

neoplasia in dogs may develop independently, which can be taken as a translational model (Gibson & Culp, 2024). The fact that canine prostate cancer patients are androgen receptor-negative to some degree can assist us in learning more about AR-indifferent human prostate cancer, one of the deadliest forms of prostate cancer with very few effective treatment options (Vasilatis et al., 2023). Since bone metastasis is one of the most common characteristics of canine prostate cancer, disease models allow comprehending the mechanisms of bone metastasis development and establishing control strategies (Nascente et al., 2022; Yu et al., 2023).

It is unfortunate that mutations and phenotypic variations occurring post-transplantation often lead to the conventional cell lines, whether they are in vitro or in vivo, losing their original tumour properties (Jiang et al., 2020). The benefit of spontaneous malignancies in dogs and cats is that it mimics the real-life scenarios of tumour heterogeneity in human beings. Also, in the case of companion animals, more than laboratory mice, their development of cancer is closer to that of human beings, as they are exposed to environmental carcinogens naturally (Giuliano, 2021). Due to these similarities, one can have a chance to test the new diagnostic and treatment strategies and find out the main principles according to which cancer develops. Animal models in cancer inquiry are necessary since they facilitate testing of carcinogenesis and therapeutic natures and the inquiry of preventive approaches (Zhou et al., 2023). However, since they differ in physiology compared to human beings and particularly in drug metabolism, distribution, and toxicity there is a need to appreciate the limitation in the utilisation of murine models only. That has changed, as these models are currently more advanced and reliable

since they can be used in vivo with human immune system mice so the human cancer immunology and immunotherapy can be investigated (Tian et al., 2020).

CONCLUSION

The given study offers reflections on cross-species and species-specific implications and the use of these insights within the veterinary oncology protocols that provide a comprehensive comparative study of oncological patterns, cancer biology and outlines of the therapy results in dogs and cats. Through the comparison of over 200 clinical cases of different type of tumours, such as mast cell tumours, squamous cell carcinomas, lymphomas, soft tissue sarcomas and carcinoma of the mammary gland, the findings indicate that despite the similarities in oncogenic activities which exist between the two species, significant differences exist in tumour behaviour, tumour progression rates and the response to treatment. Mast cell tumours and lymphomas predominated in dogs whereas squamous cell carcinomas and fibrosarcomas, in particular vaccine-associated sarcomas, were preponderant in cats. There was a greater variability in the aggressiveness of tumours in regard to histopathological grading in dogs with localised, yet infiltrative features appearing more commonly in tumours of other cats. Individual cases were considered in terms of treatment plans including these procedures, i.e. immunotherapy, chemical, radiational, and also surgical excision. Although cat response was less beneficial, especially in the cases of limited surgical margins, dogs had improved responses to combined modality therapy, especially in mast cell tumours and lymphoma. Survival analysis confirmed that the earlier the cases were detected in both species more positive results were achieved, thus the necessity of frequent screening

and rapid biopsy. There were also some prognostic biomarkers identified with the study which were well associated with tumour grade and recurrent probabilities; among them were the p53 expression and Ki-67 index. All in all, the results show that comparative oncology holds translational value in narrowing the knowledge gaps between veterinary and human cancer research as well as the case of species-specific protocols of cancer therapies by taking into account the anatomical differences in the cancerous region, genetic differences, and behavioural differences. By using a species-based approach to apply diagnostic, surgery, and chemotherapeutic strategies in a disease-specific way, veterinarians can raise the level of therapeutic accuracy and enhance both the long-term survival and quality of life of pets with cancer.

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