

A SURVEY OF NEOPLASIA IN DOMESTIC SPECIES OVER A 40-YEAR PERIOD FROM 1935 TO 1974 IN THE REPUBLIC OF SOUTH AFRICA. V. TUMOURS OCCURRING IN THE CAT

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ABSTRACT

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A total of 243 neoplasms were recorded in a survey of all the feline neoplasms which are reported in the registration files of the Veterinary Research Institute, Onderstepoort, Republic of South Africa, covering a 40-year period from 1935 to 1974.

The tissues most commonly neoplastic were the skin, followed by the lymphoid tissue, the digestive tract and the genital system, which together accounted for 76.6% of the total tumours. Squamous cell carcinomas, the commonest type of tumour, accounted for 65 (26.7%) of the 243 neoplasms, followed by lymphosarcomas with 50 (20.5%). The majority of squamous cell carcinomas involved the skin, especially that of the ear and nose. A reasonably high proportion of these tumours also occurred on the tongue and eyelid. The commonest form of distribution for lymphosarcomas was the multicentric form, followed by the alimentary, the renal and thymic forms.

Squamous cell carcinomas were the most frequent type of skin tumours, followed by basal cell tumours, mastocytomas and melanomas. The digestive tract accounted for 33 (13.5%) of the neoplasms, the 3 most commonly encountered being squamous cell carcinomas, lymphosarcomas and intestinal adenocarcinomas. The mammary gland tumours accounted for 23 (9.5%) of the total, 61% of which were carcinomas.

Other tumours encountered were fibromas, fibrosarcomas involving particularly the skin, melanomas of the skin or eye, osteosarcomas, hepatocellular carcinomas and haemangiosarcomas.

INTRODUCTION

Several surveys on the different types of animal tumours, including those of the cat, have been conducted in other countries. Cotchin (1957) recorded squamous cell carcinomas of the upper alimentary tract as the most frequent type of tumour amongst cats in England, followed by lymphosarcomas, mammary gland carcinomas and osteosarcomas of the femur and humerus. Whitehead (1967) reported that in the United States of America (USA) the most common feline neoplasms were lymphosarcomas, followed by mammary gland carcinomas and squamous cell carcinomas of the skin, especially on the ear and facial regions of the head. Jackson (1936), in a survey of the tumours of all the domestic animals in the Republic of South Africa (RSA) over a 15-year period, recorded only 2 tumours in cats, a basal cell tumour and an osteosarcoma.

Cotchin (1957) reported the incidence of squamous cell carcinomas, principally in the digestive tract and in particular on the tongue and oesophagus, whilst in the USA the majority involved the skin, especially that of the head (Schmidt & Langham, 1967; Whitehead, 1967).

Lymphosarcomas in cats have been reported in the thymus, kidneys, intestine and mesenteric lymph nodes, and may involve lymph nodes throughout the body (Cotchin, 1961; Holzworth, 1963; Mackey, 1975). Mammary carcinomas have been found to constitute the greater proportion of feline mammary neoplasms (Cotchin, 1957; Schmidt & Langham, 1967; Whitehead 1967; Mac Vean, Monlux, Anderson, Silberg & Roszel, 1978).

The aim of this survey is to report on the incidence and types of neoplasms occurring in cats in the RSA and to compare these findings with those reported in other countries.

MATERIALS AND METHODS

The data for this survey were obtained from formalin-fixed material submitted by private or state veterinarians from all parts of the RSA to the Section of Pathology of the Veterinary Research Institute, Onderstepoort, over a 40-year period from 1935 to 1974.

The registration files for each year of the survey and the written reports of each individual tumour were carefully screened, and all cases diagnosed as tumours in all the domestic species were noted. The pertinent data on these cases were recorded in a separate registration file. The tumours were then subdivided according to species. The feline tumours which are dealt with in this report have been tabulated under 14 tissues or body systems according to their specific type. The numbers for each type of tumour and the numbers and percentages constituting each tissue or body system have been tabulated.

All the cases recorded during the first 15 years of the survey and retained as preservation cases were routinely recut at 4-6 μm , stained with haematoxylin and eosin (HE) and examined under the light microscope to verify the diagnoses recorded in the registration files. Any tumours, which in the earlier years of this survey were referred to by terms no longer used today, have been reclassified and are tabulated according to the current terminology for neoplasms.

RESULTS

A total of 243 neoplasms were recorded in cats over the 40-year period. These are tabulated according to their tissue or body system of origin and their type, as well as the number and percentage that each group represents (Table 1).

The skin and its associated glands, the lymphohaemopoietic tissue, the digestive and the genital systems accounted for 76.6% of all the tumours encountered (Table 1). Squamous cell carcinomas, the single commonest type of tumour, accounted for 65 (26.7%) of the 243 tumours, followed by 50 (20.5%) lymphosarcomas, 14 (5.7%) mammary gland carcinomas and 10 (4.1%) osteosarcomas (Tables 1, 2 & 3).

The 2 commonest types of skin tumours were squamous cell carcinomas and basal cell tumours which accounted for 45 (53%) and 12 (14.1%) of the 85 skin tumours respectively. The sites of origin of the squamous cell carcinomas are shown in Table 2. For the basal cell tumours, the sites of origin of only 3 of the 12 tumours could be ascertained, one of which occurred on the neck, one on the cheek and one on the back. Mastocytomas and melanomas were relatively common skin tumours, constituting, respectively, 7 (8.2%) and 6 (7%) of the 85 neoplasms. One of the 7 mastocytoma cases occurred at multiple sites all over the body, while 2 of

TABLE 1 Tumours in cats over a 40-year period from 1935 to 1974

Tissue or body system	Type of neoplasm	Number	Total per tissue or body system	% out of 243 tumours
Skin and associated glands	Squamous cell carcinoma	45	85	35,0%
	Basal cell tumour	12		
	Mastocytoma	7		
	Melanoma	6		
	Fibrosarcoma	6		
	Fibroma	4		
	Anal gland adenocarcinoma	1		
	Ceruminous gland adenoma	1		
	Ceruminous gland adenocarcinoma	1		
	Papilloma	1		
Sebaceous gland adenocarcinoma	1			
Lymphohaemopoietic tissue	Lymphosarcoma	49	52	21,4%
	Myeloid leukaemia	1		
	Lymphoid leukaemia	2		
Digestive system	Squamous cell carcinoma	10	25	10,3%
	Intestinal adenocarcinoma	8		
	Ameloblastoma	1		
	Epulis	1		
	Fibrosarcoma	1		
	Melanoma	1		
	Papilloma	1		
	Salivary gland adenoma	1		
	Salivary gland adenocarcinoma	1		
Genital system	Mammary gland adenocarcinoma	14	24	9,9%
	Mammary gland adenoma	8		
	Benign mixed mammary gland tumour	1		
	Squamous cell carcinoma	1		
Eye	Squamous cell carcinoma	9	13	5,3%
	Melanoma	3		
	Fibroma	1		
Skeletal system	Osteosarcoma	10	12	4,9%
	Osteoma	1		
	Fibrosarcoma	1		
Respiratory system	Pulmonary adenocarcinoma	4	8	3,3%
	Nasal carcinoma	3		
	Sinus carcinoma	1		
Liver	Hepatocellular carcinoma	6	7	2,9%
	Bile duct adenocarcinoma	1		
Blood vessels	Haemangiosarcoma	5	6	2,5%
	Haemangioma	1		
Adipose tissue	Lipoma		2	0,8%
Nervous system	Meningioma	1	2	0,8%
	Neurofibrosarcoma	1		
Endocrine system	Adrenocortical carcinoma		1	0,4%
Miscellaneous tumours	Mesothelioma	2	6	2,5%
	Undifferentiated carcinoma	4		
Total			243	100%

the 6 melanomas originated on the ear. There were 10 tumours of fibrous tissue origin in the skin, 6 of which were fibrosarcomas and 4 fibromas. The specific site of origin on the body could be ascertained for only 1 of these fibrosarcomas, namely, the ear. The remaining 5 cutaneous tumours included 1 each of a papilloma, an anal gland adenocarcinoma, a ceruminous gland adenoma and adenocarcinoma and a sebaceous gland adenocarcinoma (Table 1).

Forty-five (69,2%) of the 65 squamous cell carcinomas occurred on the skin (Table 2), 16 of them were situated on the skin of the ear and 15 on that of the nose. The oral cavity accounted for 10 (15,4%) of the squamous cell carcinomas, 8 of which occurred on the tongue and 2 in the pharynx. Nine (13,8%) of the 65 squamous cell carcinomas occurred on the eyelid and a solitary tumour was encountered in the vagina (Table 2).

There were 52 tumours arising in the lymphoid or haemopoietic tissue (Table 1). The lymphoid tumours have been tabulated according to their tissue of origin or their type (Table 3). As the exact distribution of 16 of these lymphoid tumours could not be determined, the percentage incidence of the different types encountered was calculated out of 34 neoplasms. Of these 34 lymphoid tumours, 14 (41,1%) were multicentric in form, 9 (26,5%) arose in the alimentary tract, 7 (20,6%) occurred in the kidney and 3 (8,8%) in the thymus, whilst 1 (3,0%) was a case of lymphoid leukaemia (Table 3).

The digestive tract accounted for 33 (13,5%) of the total neoplasms recorded. Of these 10 (30,3%) were squamous cell carcinomas, 8 (24,2%) lymphosarcomas and 8 (24,2%) intestinal adenocarcinomas (Tables 1 & 3). Three of the 8 intestinal adenocarcinomas were of the signet-ring cell type. Other tumours encountered in the

TABLE 2 Sites of origin of 65 squamous cell carcinomas

Tissue or body system	Specific site	Number	Total in tissue or body system	% of 65 tumours
Skin	Ear	16	45	24.6%
	Nose	15		23.0%
	Site undetermined	14		21.6%
Oral cavity	Tongue	8	10	15.4%
	Pharynx	2		
Eye	Eyelid	9	9	13.9%
Female genital system	Vagina	1	1	1.5%

TABLE 3 Types of tissues/organs affected in 50 cases of feline lymphosarcoma

Tissue/organ affected or form	Number
Widespread in tissues of body (multicentric form)	14
Intestine and/or mesenteric lymph nodes	8
Stomach (pyloric region)	1
Kidney	7
Thymus and mediastinal lymph nodes	3
Lymphoid leukaemia	1
Undetermined form*	16

* Only lymph nodes were submitted

digestive tract included 1 each of an adamantinoma, epulis, melanoma, papilloma, salivary gland adenoma and salivary gland adenocarcinoma (Table 1).

Mammary gland neoplasms constituted 23 (96%) of the 24 neoplasms arising in the female genital tract (Table 1). Fourteen (61%) of the mammary tumours were mammary gland adenocarcinomas, 8 (34.8%) were adenomas and 1 was a benign mixed mammary gland tumour. The remaining tumour was a squamous cell carcinoma arising in the vagina.

Thirteen (5.3%) of the total 243 neoplasms originated in the eye. Nine (69%) of these were squamous cell carcinomas, and 3 (23%) were melanomas, whilst 1 fibroma was also recorded (Table 1).

There was a total of 10 melanomas, 6 of which occurred on the skin, 3 arose from the eye and 1 on the lip (Table 1).

The skeletal system accounted for 12 (4.9%) of the 243 neoplasms (Table 1), 10 of which were osteosarcomas. Two of the latter arose in the femur and 1 in the lumbar vertebrae, but the site of origin of the remaining 7 could not be determined. The remaining 2 tumours included an osteoma of the humerus and a fibrosarcoma (Table 1).

Fibromas and fibrosarcomas together accounted for 13 (5.3%) of the 243 neoplasms, 8 of which were fibrosarcomas and 5 fibromas. Six of the fibrosarcomas originated in the dermis, 1 on the gum and 1 in the skeletal system. One of the fibromas occurred on the eyelid, while the remaining 4 arose in the dermis (Table 1).

The respiratory system, liver and blood vessels had an almost equal incidence of neoplasms with respectively 8 (3.3%), 7 (2.9%) and 6 (2.5%) of the total 243 tumours (Table 1). The respiratory system tumours included 4 pulmonary adenocarcinomas, 3 nasal carcinomas and 1 sinus carcinoma. Six of the 7 hepatic tumours were hepatocellular carcinomas and only 1 a cholangiocarcinoma.

The 6 vascular tumours included 5 haemangiosarcomas and 1 haemangioma. The haemangiosarcomas occurred primarily in the dermis of the forelimbs, ear or neck, while 1 originated in the liver.

The remaining 11 (2.5%) neoplasms included 2 lipomas, 2 mesotheliomas, 4 undifferentiated carcinomas and 1 each of a meningioma, neurofibrosarcoma and adrenocortical carcinoma.

DISCUSSION

The skin, haemolymphopoietic tissue, digestive and genital systems accounted for 76.6% of the 243 feline tumours. These tissues have been reported to constitute similar proportions, ranging from 63.5–76.4% by other workers (Cotchin, 1957; Schmidt & Langham, 1967; Whitehead, 1967; MacVean *et al.*, 1978).

In this survey, the skin was the most commonly encountered neoplastic tissue type, accounting for 35% of the 243 tumours. Cotchin (1957) reported the alimentary tract to be the most commonly affected tissue, followed by the skin with 25% of 464 tumours, while Whitehead (1967) found the lymphohaemopoietic tissue to be the most frequently affected tissue with 30% of 165 neoplasms.

Squamous cell carcinomas were reported as the most frequent type of skin tumour (53% of the 85 skin tumours) followed by basal cell tumours (14.1%). Whitehead (1967) recorded 46.1% of 26 skin tumours as either squamous cell carcinomas or basal cell tumours, the majority of which were squamous cell carcinomas. Cotchin (1961), on the other hand, reported that basal cell tumours occurred more frequently than squamous cell carcinomas. Forty-five (69.2%) of the 65 squamous cell carcinomas recorded in this series involved the skin. Approximately half of those for which the site of origin could be determined occurred on the ears and the other half on the nose. Feline cutaneous squamous cell carcinomas reportedly occur more commonly in white cats and primarily affect the sparsely covered regions of the head, particularly the tips of the ears or the facial region (Cotchin, 1961; Whitehead, 1967). The high prevalence of squamous cell carcinomas on the head and eyelids of cats in this survey can possibly be ascribed to the high sunlight intensity in the RSA.

Squamous cell carcinomas were also encountered on the eyelids or vagina or in the oral cavity. The oral cavity, especially the tongue, accounted for 15.4% of these tumours. In the United Kingdom, Cotchin (1957) reported that the majority of squamous cell carcinomas arose in the alimentary tract, particularly on the tongue and oesophagus.

Mastocytomas were the 3rd commonest type of skin tumour, although they accounted for only 8.2% of the 85 skin tumours and 2.8% of the total 243 tumours. Schmidt & Langham (1967) found them to be the 4th most frequently encountered feline tumour, representing

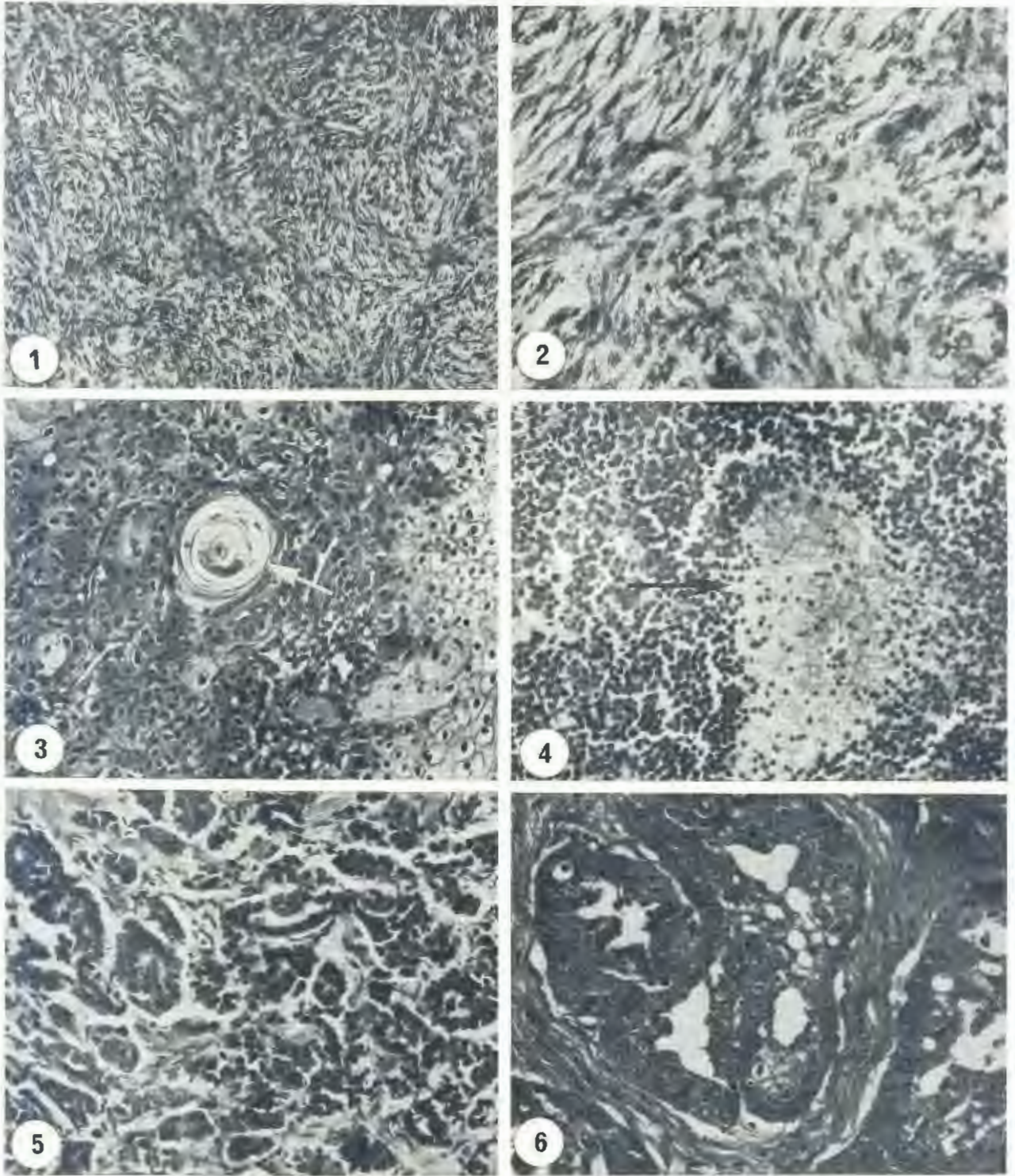


FIG. 1 Fibrosarcoma in subcutis: cells arranged in an interwoven pattern: HE \times 75
FIG. 2 Fibrosarcoma: spindle-shaped cells lying in different planes: HE \times 480
FIG. 3 Squamous cell carcinoma at tip of ear. Note keratin pearl (arrow): HE \times 120
FIG. 4 Mastocytoma in skin showing an area of oedema and necrosis (arrow): HE \times 120
FIG. 5 Tubular mammary gland adenocarcinoma: HE \times 480
FIG. 6 Basal cell tumour, adenoid pattern: HE \times 480

5% of all the tumours. A lower incidence, however, was recorded by other workers (Cotchin, 1961; MacVean *et al.*, 1978).

Ceruminous gland adenocarcinomas have been reported as a relatively common feline skin tumour (Cotchin, 1961). He reported 6.4% of 125 cutaneous neoplasms to be of this type. Only 1 ceruminous gland adenocarcinoma was recorded in this survey. Schmidt & Langham (1967) also recorded a low incidence for this neoplasm, while Whitehead (1967) and MacVean *et al.* (1978) did not record any in their surveys.

Fibromas and fibrosarcomas were relatively frequently encountered in this survey, the most common site for them being the skin. They accounted for 11.7% of the 85 skin neoplasms. Cotchin (1961) reported 21.6% of 125 skin tumours to be either fibromas or fibrosarcomas. A respective incidence of 11.2% and 8.2% for fibromas and fibrosarcomas was recorded by Schmidt & Langham (1967) and MacVean *et al.* (1978), although they did not specify the site of origin of these 2 tumours. In this survey, these 2 tumours together accounted for 5.3% of the total 243 tumours.

In a report on soft tissue sarcomas of the cat, 14 out of 23 tumours were fibrosarcomas, all of which arose in the dermis or subcutis, particularly on the limbs (Brown, Patnaik, Mooney, Hayes, Harvey & MacEwen, 1978). These authors also recorded 7 neurofibrosarcomas and 2 chondrosarcomas. In this survey only 1 neurofibrosarcoma and no chondrosarcomas were encountered. According to Snyder & Theilen (1969), fibrosarcomas of the skin may be caused by the same C-type RNA virus as that which causes feline lymphosarcoma and leukaemia. As the latter 2 conditions occur commonly in cats, this could explain why cutaneous fibrosarcomas are relatively common in this species.

The lymphohaemopoietic tissue accounted for 52 (21.4%) of the total neoplasms, 49 of which were lymphosarcomas. The latter was the 2nd most frequent type of tumour in this survey. In the USA, lymphosarcomas were found to be the commonest type of tumour, accounting for a range of 22–33.9% of the total tumours in 3 separate surveys (Schmidt & Langham, 1967; Whitehead 1967; MacVean *et al.*, 1978). In separate surveys conducted in England, the New York region of the USA and Scotland, feline lymphosarcomas were reported as being leukaemic or multicentric in nature (where various lymph nodes throughout the body as well as the liver and spleen are affected) or arising in the kidneys, the intestines (especially the terminal ileum) or the thymus, together with the anterior mediastinal lymph nodes (Cotchin, 1957; Holzworth, 1963; Mackey, 1975).

Cotchin (1957) reported the digestive tract to be the most frequent site for neoplasia in cats, 55% of the tumours being squamous cell carcinomas, 17% lymphosarcomas and 7% intestinal adenocarcinomas. Brodey (1966) found lymphosarcomas and intestinal adenocarcinomas to be the most common gastrointestinal tumours, whilst squamous cell carcinomas occurred only in the oral cavity. The oesophagus followed by the tongue were the principal sites for squamous cell carcinomas (Cotchin, 1957). In this survey digestive tract tumours were the 3rd most commonly encountered group of tumours, 30.3% of which were squamous cell carcinomas (all of which occurred on the tongue) 24.2% lymphosarcomas and 24.2% intestinal adenocarcinomas. The majority of lymphosarcomas involved the small intestine, but 1 occurred in the gastric pylorus. Lymphosarcomas arising in the stomach of the cat have also been recorded by other workers (Cotchin, 1957, Brodey, 1966).

There were 23 mammary gland neoplasms, which constituted 9.5% of the 243 tumours. Sixty-one per cent were mammary carcinomas, 34.8% adenomas and one was a mixed mammary gland tumour. Similar findings to the above were recorded in surveys conducted in the USA (Schmidt & Langham, 1967; Whitehead, 1967). Feline mammary carcinomas have been shown to have a high rate of recurrence and a relatively high metastatic rate (Nielsen, 1952).

The skeletal system constituted 12 (4.9%) of the 243 tumours, 9 of which were osteosarcomas. Whitehead (1967) reported osteosarcomas to be the most common type of skeletal tumour and noted that the skeletal system accounted for 6.7% of 165 tumours, while Cotchin (1957) recorded 8.1% of 464 tumours as osteosarcomas. He noted the humerus and femur to be the principal sites of origin for this neoplasm in the cat.

Respiratory system tumours were rarely encountered and constituted only 3.3% of the 243 neoplasms in this survey. A similar low incidence has been recorded by other workers (Cotchin, 1957; Whitehead, 1967), whilst, in another 2 surveys on feline tumours, no respiratory tumours were encountered (Schmidt & Langham, 1967; MacVean *et al.*, 1978).

Hepatic tumours are rarely encountered in the cat. Schmidt & Langham (1967) recorded only 6 hepatic tumours out of a total of 258 neoplasms, 4 of which were cholangiocarcinomas and 2 hepatocellular carcinomas. In other surveys hepatic tumours were either not encountered or accounted for only a small proportion (Cotchin, 1957; Whitehead 1967; MacVean *et al.*, 1978). In the present survey hepatic tumours constituted only 2.9% of the 243 tumours.

Tumours of the nervous system were extremely rare. Only one neurofibrosarcoma and one meningioma were recorded. Whitehead (1967) recorded 11 tumours out of 165 as arising in the nervous system, all of which were meningiomas. Nafe (1979) in a review of meningiomas in cats stated that meningiomas were the commonest tumour of the central nervous system in this species.

The vascular system, rarely neoplastic, accounted for only 6 of the total 243 tumours. Five of these were haemangiosarcomas, 4 of which occurred in the skin and 1 in the liver.

In conclusion, although a wide variety of tissues can become neoplastic, the commonest tumours in cats would seem to be squamous cell carcinomas, lymphosarcomas and mammary gland carcinomas.

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