International Journal of Veterinary Sciences and Animal Husbandry

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Sweat gland tumours in dogs: Epidemiology and clinicopathological diagnosis of 32 cases in Chennai

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Abstract
In the present study, 32 cases of sweat gland tumours comprising 7 cases of sweat gland adenoma and 25 cases of sweat gland adenocarcinoma were identified in dogs, based on cytological and histopathological examination. Sweat gland adenomas were most frequently observed in Labrador retriever breed, male dogs, 5-10 years age group of dogs, with the inguinal region being the predominant tumour site. Sweat gland adenocarcinomas were primarily diagnosed in non-descript, male dogs, 1-5 years age group of dogs and with a higher prevalence in the head and limb regions. Cytologically, adenomas showed individual to clustered round to oval neoplastic cells with round vesicular nuclei, while histologically they exhibited multilayered cuboidal cells with luminal eosinophilic secretions. Adenocarcinomas revealed pleomorphic neoplastic cells with prominent nucleoli on cytology and cuboidal to columnar cells with basoeosinophilic to eosinophilic secretions and numerous mitotic figures in histopathological examination.

Keywords: Dog, canine tumours, sweat gland adenoma, sweat gland adenocarcinoma, cytology, histopathology

Introduction
Sweat gland tumours are the skin adnexal tumours in dogs and are routinely diagnosed through cytological and histopathological evaluations. According to the World Health Organisation (WHO) classification of tumours of the skin and its appendages, sweat gland tumours are histologically categorized as papillary syringadenoma, cystadenoma, spiradenoma, and mixed tumours, as well as carcinomas of the sweat glands (Weiss and Frese, 1974) [11].

In canine, of the two types of sweat glands present, namely the apocrine and eccrine sweat glands, tumours are more frequently encountered in the apocrine sweat glands with an incidence of overall 1.1% of all skin tumours (Hauck, 2013) [5]. Earlier, Goldschmidt and Shofer (1992) [3] have stated that approximately 70% of canine apocrine tumours are benign in nature, but malignant ones tend to recur locally and metastasize to regional lymph nodes and the lung.

Simko *et al*. (2003) [7] emphasized that intravascular invasion is a significant indicator of systemic metastasis in cases of apocrine gland adenocarcinoma. Supporting this, Subapriya *et al*. (2021) [8], through Transmission Electron Microscopy (TEM), observed tumour emboli comprising neoplastic cells within blood vessels which were accompanied by anisocytosis and poikilocytosis of erythrocytes, suggesting haematogenous dissemination of the tumour.

Grossly, sweat gland tumours tend to be solitary, well circumscribed, firm raised tumours that are often ulcerated and in cytological examination, neoplastic sweat gland cells are round to slightly angular in shape with moderate sized round nuclei eccentrically placed in cytoplasm and a variable amount of pale, granular cytoplasm when found individually and when found in sheets, the cytoplasmic borders may be indistinct (Cowell *et al*., 2007) [2].

In histopathological examination, sweat gland adenomas are lined by a single layer of cuboidal epithelium with an abundant granular eosinophilic cytoplasm and basally located small nuclei and sweat gland adenocarcinomas have a population of neoplastic cells with round to ovoid, normochromic to hyperchromic nuclei and prominent nucleoli with variable mitotic rate usually from one to four mitosis per high power field (Goldschmidt and Hendrick, 2002) [4].

Immunohistochemical studies on sweat gland adenomas and sweat gland adenocarcinomas in dogs revealed moderate expression of cytokeratin and negative expression of vimentin which denoted the epithelial lineage of sweat gland tumours (Subapriya *et al*. 2021) [9]. The authors further added that, though immunohistochemical studies are a bit expensive to be employed for all tumour suspected cases, yet, they serve as a guiding tool in the diagnosis of poorly differentiated, anaplastic cases where cytological and histopathological diagnosis is inconclusive.

Transmission Electron Microscopic studies of sweat gland adenocarcinoma showed tumour cells with features of anisocytosis and anisokaryosis, multinucleation, margination of heterochromatin, atypical nuclei with prominent nucleoli containing coarse chromatin, altered nuclear to nucleolar ratio along with subcellular findings such as numerous mitochondria found to be distributed in cytoplasm along with lipid vacuoles, rough endoplasmic reticulum, Golgi bodies, secretory vesicles and multivesicular bodies and disrupted microvilli seen as projections of outer surface of the cell (Subapriya *et al*. 2021) [8].

Based on this background, the present study was undertaken to investigate the cyto-morphological and histo-morphological features of canine sweat gland tumours, and to analyse their epidemiological profile.

Materials and Methods
The present study involved cytological and histopathological screening of samples collected from canine tumour suspected cases. The samples were collected from the cases presented to the Madras Veterinary College Teaching Hospital (MVCTH), Chennai-07 with the history and clinical presentation of masses. The collected samples were thereafter processed in Centralized Clinical laboratory, Madras Veterinary College, Chennai-07 for laboratory diagnosis and confirmation.

Fine-needle aspiration cytology (FNAC) samples and impression smears intended for cytological examination were stained using the Leishman-Giemsa (LG) stain. Biopsy tissues collected for histopathological analysis were fixed in 10% neutral buffered formalin, processed, and stained following the protocol described by Bancroft and Gamble (2008) [1]. The prepared cytological and histopathological smears were subsequently examined under various magnifications using a light microscope, and tumour diagnoses were made based on observed morphological characteristics.

Relevant details of dogs diagnosed with sweat gland tumours including breed, sex, age, tumour location, and associated clinical history were recorded from the sample processing requisition forms.

Results and Discussion
Sweat gland tumours
Incidence
In the present study, a total of 32 cases of sweat gland tumours were diagnosed in dogs through pathological examination, accounting for an overall incidence of 0.57% of all canine tumours recorded during the study period.

Previous studies have reported varying incidence rates for sweat gland tumours. Goldschmidt and Hendrick (2002) [4] documented that sweat gland tumours constitute approximately 0.7% to 2.2% of all skin-related tumours in dogs. In contrast, Subapriya *et al*. (2021) [10] reported a higher incidence rate of 15.63% in their study specifically focusing on canine skin tumours. The lower incidence observed in the present study is attributed to the fact that it reflects the proportion of sweat gland tumours among all canine tumours diagnosed, without limiting the scope to cutaneous tumours alone.

Grossly, sweat gland tumours exhibited varied presentations, typically appearing as solitary, round to spherical masses with well-defined margins demarcating them from the surrounding tissues. In several cases, ulceration and bleeding were observed. Dogs with malignant sweat gland adenocarcinomas, particularly those located on the limbs, exhibited signs of pain and discomfort, especially during movement, likely due to ulceration and tumour invasion into surrounding structures.

Sweat Gland Adenoma
Incidence
Seven cases of sweat gland adenoma were diagnosed during the study period, representing 0.12% of all canine tumours documented. By comparison, Subapriya *et al*. (2021) [10] have earlier reported an incidence of 1.88% of sweat gland adenoma in their study specifically limited to canine skin tumours.

Breed Distribution
Tumours occurred in five breeds, with Labradors predominating (3/7), (Figure 1). This likely reflects the disproportionately high Labrador population in Chennai, driven by owner preference rather than a true breed predisposition.

Sex Distribution
All affected dogs were male (7/7) (Figure 2). This is attributed to the male-skewed background population in the city again related to ownership preference.

Age Distribution
Most cases (6/7) were recorded in adults aged 5-10 years and a lone case occurred in the 1-5 year group. No tumours were detected in dogs less than 1 year or more than 10 years of age (Figure 3).

Anatomical Location
Lesions were most common in the inguinal region (4/7) and ear (2/7) (Figure 4). This mirrors the classic inguinal/axillary predilection for sweat-gland tumours noted by Goldschmidt and Hendrick (2002) [4].

Gross appearance
Sweat gland adenomas were presented as solitary to multiple, irregularly round-to-oval or spherical masses, 1-2 cm in diameter, with well-defined margins (Figure 5).
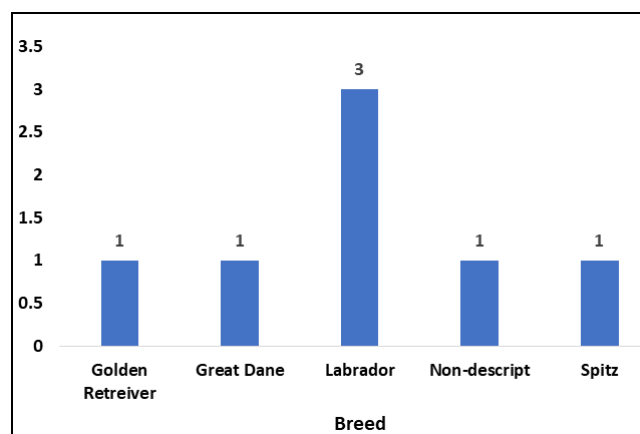

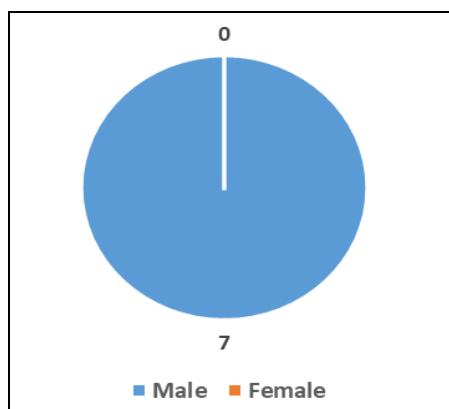**Fig 1:** Breed wise incidence of canine sweat gland adenoma (N=7)

Fig 2: Sex wise incidence of canine sweat gland adenoma (N=7)
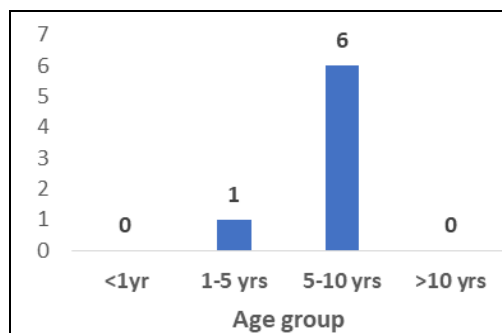

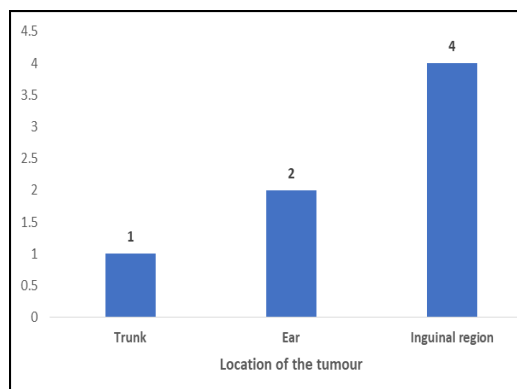**Fig 3:** Age wise incidence of canine sweat gland adenoma (N=7)

Fig 4: Location wise incidence of canine sweat gland adenoma (N=7)

Cytological findings
Fine-needle aspirates and impression smears showed individual cells and small clusters of round-to-oval neoplastic cells with round, vesicular nuclei and pale granular cytoplasm consistent with descriptions by Cowell *et al*. (2007) [2].

Fig 5: Sweat gland adenoma-Labrador-Inguinal region-Hard, nodular mass

Histopathological findings
Histopathological sections revealed single to multi-layered cuboidal cells with eosinophilic granular cytoplasm lining variably sized glandular lumina, many containing eosinophilic secretions (Figure 6), which was diagnostic of sweat gland adenoma.
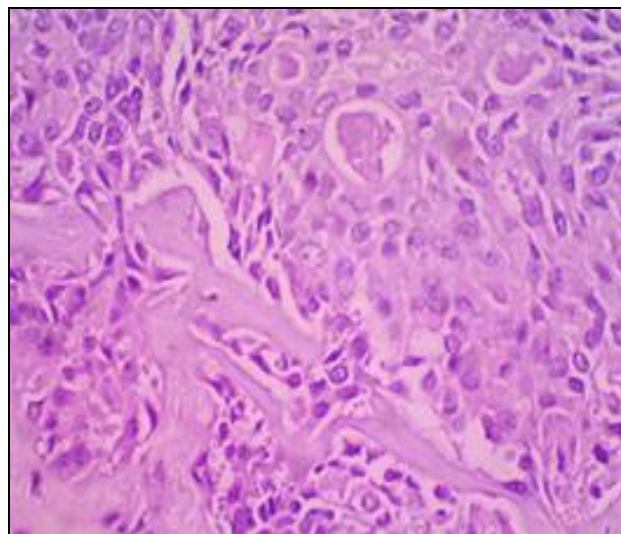
Fig 6: Sweat gland adenoma-Round to vesicular nuclei, lumen containing eosinophilic secretion H&E 400

Sweat gland adenocarcinoma
Incidence
During the study period, sweat gland adenocarcinoma was diagnosed in 25 dogs based on cytological and histopathological evaluations, accounting for an incidence of 0.44% of all tumours diagnosed in dogs. Earlier, Subapriya *et al.* (2021) [10] have reported an incidence of 13.75% of sweat gland adenocarcinoma in their study on canine skin tumours.

Breed Distribution
The tumours were identified in nine different breeds, with the highest incidence observed in non-descript dogs (N=8), followed by Labradors (N=6), (Figure 7). The greater frequency in these groups may be attributed to their larger representation in the general canine population of Chennai, influenced by pet owners' preferences.

Sex Distribution
The 25 cases, male dogs were more frequently affected (N=13), (Figure 8). This male predominance could be due to a higher proportion of male dogs in the general population of the region, again reflecting owners' preferences.

Age Distribution
The highest number of cases occurred in dogs aged 1-5 years (N=10). Notably, no tumours were detected in dogs under one year of age (Figure 9), suggesting that sweat gland adenocarcinomas primarily affect young to middle-aged animals.

Anatomical Location
Anatomically, the majority of tumours were located on the head (N=10), limbs (N=7), and neck (N=4), (Figure 10). These findings align with Nibe *et al.* (2005) [6], who reported a predilection for sweat gland neoplasms in the head, neck, and limbs.
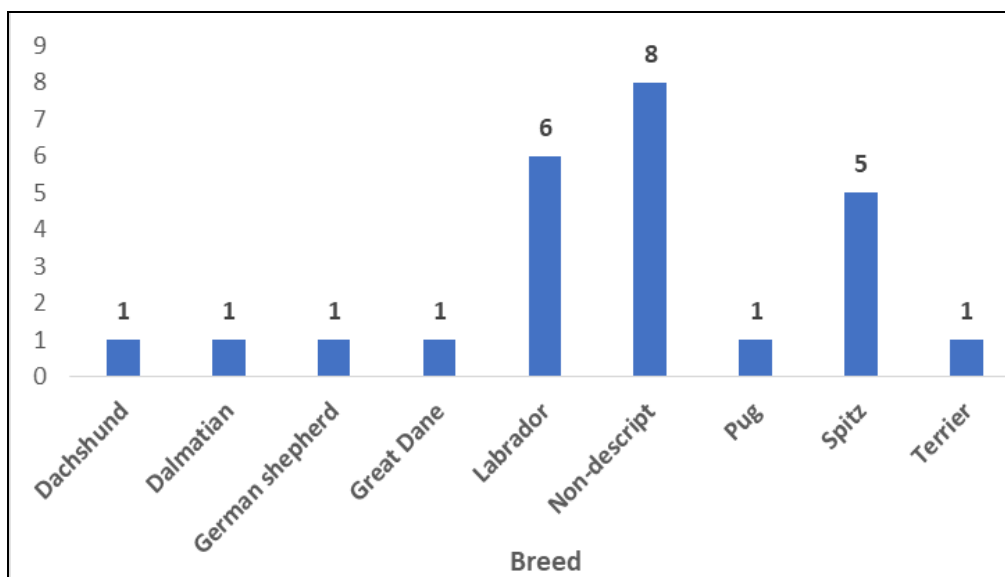
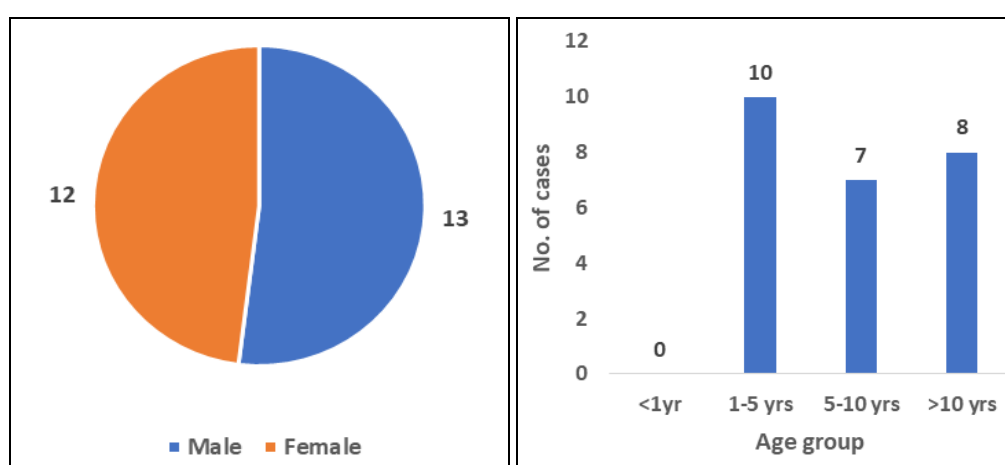**Fig 7:** Breed wise incidence of canine sweat gland adenocarcinoma (N=25)

Fig 8: Sex wise incidence of canine sweat gland adenocarcinoma (N=25)

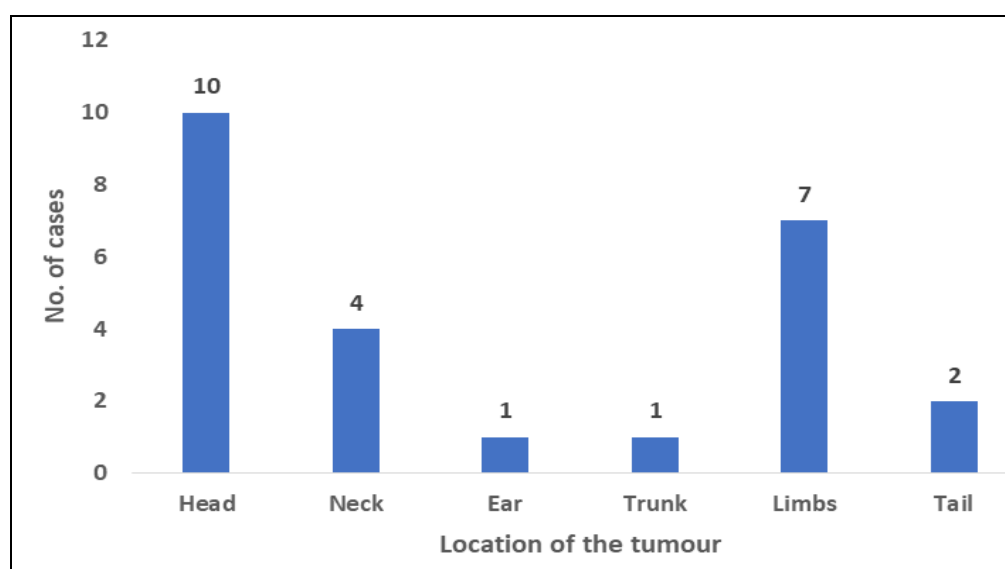**Fig 9:** Age wise incidence of canine sweat gland adenocarcinoma (N=25)

Fig 10: Location wise incidence of canine sweat gland adenocarcinoma (N=25)

Gross Appearance
Morphologically, the tumours ranged in size from 4 to 8 cm in diameter, often irregularly spherical and soft to firm in consistency. Most lesions exhibited ulcerated surfaces, and the cut surfaces were typically light white to pink, occasionally showing cauliflower-like multilobulations (Figure 11, 12).

Cytological Findings
Cytological examination revealed clusters of pleomorphic

neoplastic cells (Figure 13) demonstrating marked anisocytosis and anisokaryosis. The nuclei were round to oval, often containing multiple, prominent nucleoli. Additionally, scattered erythrocytes and neutrophils were frequently observed. These features were in accordance with the findings of Subapriya *et al.* (2021) [8].

Histopathological Findings

Histologically, the tumours exhibited ducts and tubules of varying sizes, lined by single to multilayered cuboidal to columnar pleomorphic neoplastic cells (Figure 14-16). These cells featured round to oval, vesicular nuclei, and baso-eosinophilic to eosinophilic secretions within the glandular lumen. Tubulopapillary patterns were noted in four cases. Features indicative of malignancy, such as prominent nucleoli and numerous mitotic figures, were common. Focal necrosis with mononuclear cell infiltration was observed in some cases. In a few instances, tubular structures surrounded by myoepithelial cells were identified. These histological features were consistent with the findings of Subapriya *et al.* (2021) [8].

Fig 11: Sweat gland adenocarcinoma-non-descript-left forelimb-spherical ulcerated mass
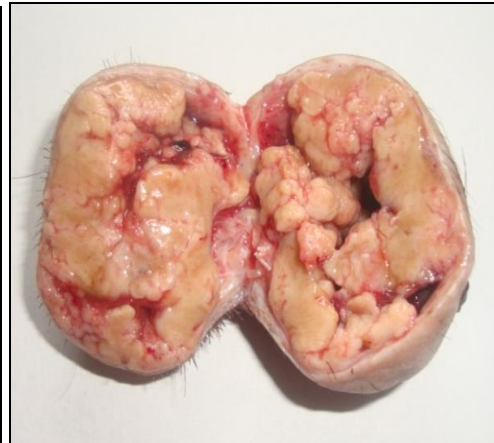

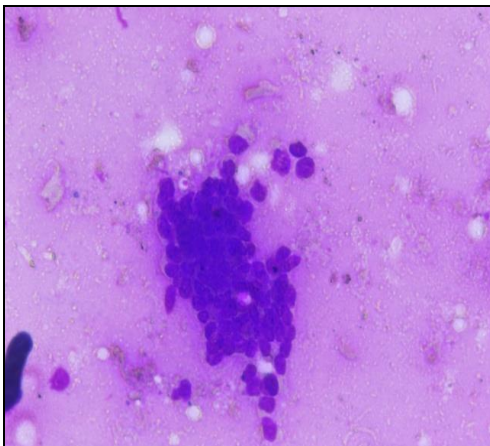**Fig 12:** Sweat gland adenocarcinoma-cut section-yellowish white lobulations with haemorrhage

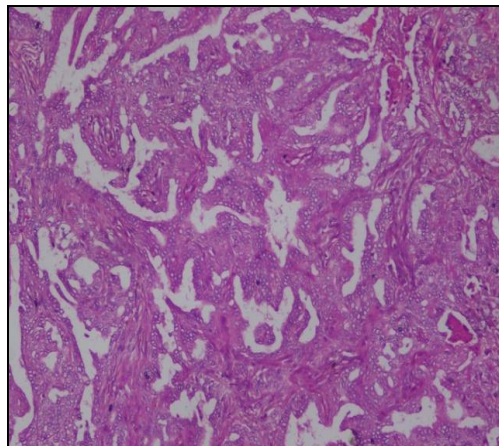**Fig 13:** Sweat gland adenocarcinoma-cluster of pleomorphic neoplastic cells LG x 10

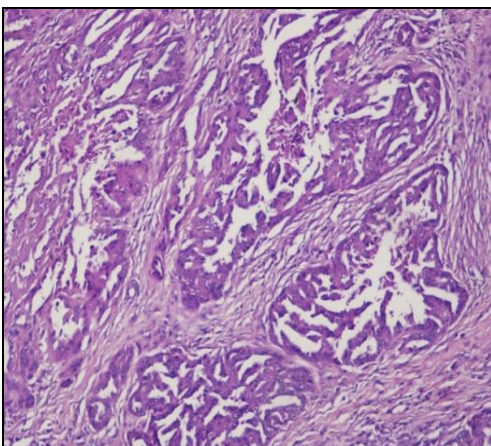**Fig 14:** Sweat gland adenocarcinoma-Tubulopapillary pattern H&E x 100

Fig 15: Sweat gland adenocarcinoma-Tubulopapillary pattern H&E x 100
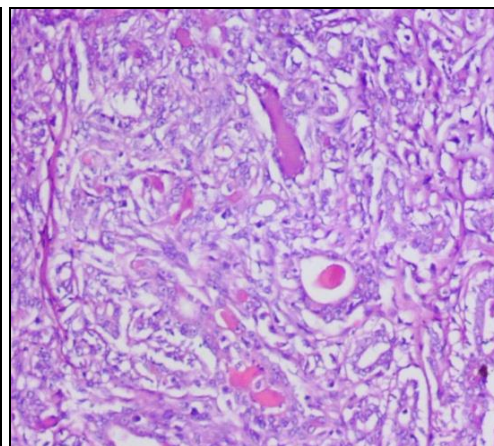

Fig 16: Sweat gland adenocarcinoma-Pleomorphic neoplastic cells with vesicular nuclei H&E x100

Conclusions

During the study period, 32 sweat gland tumours were diagnosed on the basis of cytology and histopathology of tumour-suspect clinical samples collected from dogs. Cytological examination proved clinically advantageous for the preliminary diagnosis of these tumours, while histopathology played a crucial role in grading the tumour and assessing surgical margins, aiding in the planning of rationale surgical excision.

The epidemiological profile of sweat gland tumours in the geographical region studied *viz*. Chennai cohort, revealed a higher occurrence in Labrador Retrievers and non-descript breeds, with a greater representation in male dogs. Age-wise, the tumours were predominantly observed in dogs aged 1-5 years and 5-10 years. Anatomically, the inguinal region, head, and limbs were identified as the most common tumour sites.

In this direction, multicentre studies with larger, geospatially diverse case series in future will aid at large for refining the epidemiological risk factors for canine sweat gland tumours and in establishing evidence-based screening and management guidelines for spontaneously occurring sweat gland tumours in dogs.

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