



CASE REPORT

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Cyto-histopathological and outcome features of the prepuce squamous cell carcinoma of a mixed breed dog

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Abstract

Background: Squamous cell carcinomas (SCCs) are uncommon, high-grade tumors, predominantly composed of round cells in the prepuce. The aim of this study is to better define the clinicopathologic features of this neoplasm.

Case report: We conducted cyto-histopathologic analysis on the manifestations of the prepuce SCC by H & E staining in a terrier mix dog. Grossly, tumor was large, multiple erythematous patch, and ulcerated masses frequently affecting the prepuce and deeply invading to distal prepuce out from the ventro-lateral of penis and the tumor covered by a necrotic discharge. Cytological evaluation of fine-needle aspirates from the cutaneous mass from the prepuce comprised of round nuclei, coarse chromatin pattern, distinct nucleoli and nuclear pleomorphism. Furthermore, the neoplastic cells were pleomorphic, round to caudate in shape, exhibiting prominent anisokaryosis and anisocytosis with rare mitotic features. Microscopically, the lesions were predominantly composed of atypical round cells disposed in interlacing fascicles. Frequent findings include keratin formation, horn pearls, mitoses and cellular atypia. The cells showed distinct borders, ranged from polygonal to round or elongate and had moderate amounts of eosinophilic cytoplasm.

Conclusion: The histopathologic features coupled with the cytopathology findings led to a diagnosis of squamous cell carcinoma. To the authors' knowledge, this is the first time that multiple erythematous plaques have undergone malignant transformation in a terrier mix dog.

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Keywords: Histopathology, Cytology, Dog, Prepuce, Tumour

Background

The prepuce, or sheath, is a voluminous, folded "sleeve" of integument covering the mobile portion of the quiescent penis [1]. The prepuce consists of the haired external lamina, which is continuous with the skin of the abdominal wall and an internal lamina which is in contact with the penis. Neoplasms of the penis and prepuce include squamous papillomas, squamous cell carcinomas, sarcoids, melanomas, mastocytomas, and hemangiomas [2-4]. The

penis is covered with skin and can thus be affected by tumours of epithelial or mesenchymal origin. Squamous cell carcinomas in this region frequently cause discomfort but can also lead to more severe sequel and even result in death.

Cutaneous squamous cell carcinomas (SCCs) are malignant epidermal neoplasms of humans and animals. Squamous cell carcinoma of the penis and prepuce is demonstrated in horses, dogs and bulls. In dogs, squamous cell carcinoma located in the penis or prepuce is similar to horse neoplasm, but keratinization is poor or

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absent. Metastases take place in over 25% of cases, usually in inguinal lymph nodes [5,6]. Primary SCC may occur at any anatomic site on the penis. It most often occurs on the glans although it may also develop on the prepuce, both the glans and the prepuce, the coronal sulcus, and the shaft. Invasion of the shaft by a tumor originating from more distant sites may also be observed. Squamous cell carcinoma (SCC) accounts for at least 95% of all penile malignancies. It represents approximately 2% of all cancers of the male genitalia and comprises 0.3-0.5% of the cancer-bearing male population [7,8].

In man, infection with papilloma viruses (HPV) has been reported to be a risk factor for the development of SCC, but secondary factors must also be [9,10]. Squamous cell carcinomas (SCCs) are the most common form of penile and preputial neoplasia; however, squamous cell papillomas, melanomas, fibromas, fibrosarcoma and haemangiomas have been reported [11,12]. Penile and/or preputial neoplasia may cause discomfort and in advanced cases can result in systemic disease [13,14]. In addition, SCCs are the commonest neoplasm involving the penis, prepuce or both [15]. Moreover, prepuce SCC is considered a loco-regional disease with a fairly predictable pattern of progression. Widespread dissemination occurs in at least one-third of the patients. Local recurrence (defined as the presence of tumor after a primary treatment affecting any remainder tissue, including skin, erectile corpora, or urethra) present in up to 30% of the patients increases the risk of regional inguinal and pelvic lymph nodes metastases. Papillomaviruses (PVs) are a diverse group of viruses that cause the mouth and genitalia SCCs of people [16]. Additionally, some evidence suggests that PVs may act as a cofactor with ultraviolet (UV) light to promote the development of human cutaneous SCCs [17,18]. However, regarding nonhuman species, evidence suggesting a causal association between PVs and cutaneous SCCs, which has been reported in cats, rabbits, horse, bandicoots and some rodents [19]. In dogs, seven papillomavirus (PV) types have been completely described [20,21]. Of these, *Canis familiaris* papillomavirus 2 (CfPV 2), CfPV 3 and CfPV 7 have been previously detected in canine cutaneous SCCs.

The diagnosis of cancer is usually confirmed by a histologic examination. Histopathologic examination is essential to establish the diagnosis and to provide information about the extension of the tumour in deeper tissues. Upon microscopy, squamous cell carcinoma (SCC) may have different histologic features according to the degree of differentiation. The histological evidence of PV infection within the SCCs could support a causative association between PVs and a proportion of canine cutaneous SCCs [16-19,22]. The aim of the study was to evaluate cytopathological and outcome features of squamous cell carcinoma of the prepuce.

Case presentation

Animal welfare

This study was approved by the Animal Ethics Committee at Tehran University (Ethics code permit no. TU2013-1-11-007Y). The animal was placed in shade, in standard conditions, water ad libitum, and without restriction of movement according to the guidelines of the Institutional Animal Ethical Committee of the Tehran University of Animal Science, Iran. Surgery was performed under aseptic conditions and sedation by injection of xylazine hydrochloride (0.05 mg/kg) followed by 2% lignocaine hydrochloride.

Clinical case reports

The present study was carried out on a terrier dog. This animal was admitted to Tehran Veterinary Teaching Hospital of the Faculty of Veterinary Medicine, Tehran University, Tehran, Iran. Diagnosis was based on history of the case and clinical examination of each mass including location, size and age as well as histopathological examinations.

Clinical examination was performed of the penis and prepuce. Examination of the penis itself and the internal fold of the prepuce required sedation with intravenous detomidine 1% (Domosedan, Pfizer) 0.01 mg/kg body weight. Furthermore, superficial inguinal lymph nodes were examined.

In April 2012, a 8-year-old, 9 kg, intact male, terrier mix breed dog was examined because of multiple, 10 × 8 × 9 mm in diameter, round, extradermal nodule around the prepuce with history of two months difficulty in retraction of the prepuce. Firstly, only a slightly scaly, erythematous patch had been noted. At our initial evaluation, an erythematous and focally ulcerated plaque and evidence of ulceration and bleeding was noted on manipulation. Inguinal lymph nodes, abdominal and respiratory system revealed normal upon examination. Furthermore, owner complained from foul-smelling discharge from the ulcer. Moreover, clinical examination revealed an infiltrated porcelain white plaque over the mucosal surface of the prepuce along with a soft friable, red colored erythematous plaque over the penis glans, the surface of which was covered by a necrotic discharge.

Biopsy demonstrated a well-differentiated in situ squamous cell carcinoma, and therapy was initiated using topical 5-fluorouracil cream and imiquimod cream twice to five times per week, but these creams did not respond for multiple nodules treatment on prepuce sheath. Thus, at next stage, the observed lesions were surgically resected through a wide surgical excision in the surrounding healthy tissues by 1-2 cm and an impression smear of the tissue was prepared and stained with Giemsa. The rest of the tissue was subjected to histopathologic evaluation. One formalin-fixed, paraffin wax-embedded section of

each neoplasm was stained with haematoxylin and eosin (HE). The tumour was classified independently by two pathologists in order to confirming the diagnosis according to the WHO criteria [23]. These criteria included the following histomorphological features: extent of tumour (invasiveness), cellular morphology, size of cytoplasmic granules, mitotic activity and stromal reaction. Invasiveness was assessed as follows: non-invasive (tumours confined to the superficial dermis and interfollicular spaces); moderately invasive (tumours with lower dermal and limited subcutaneous tissue invasion); highly invasive (tumours with massive infiltration of subcutaneous and deep tissue). Mitotic activity was assessed on toluidine blue-stained sections, five high power fields (hpf) being evaluated in each case with a $\times 40$ objective. The data were expressed as mean number of mitoses per hpf (mitotic index).

Smears revealed a large number of malignant squamous cells occurring either individually or in clusters. The cells were pleomorphic, round to caudate in shape exhibiting prominent anisokaryosis and anisocytosis. In the current case, round epithelial cells that tended to form packets (carcinomatous component; Figure 1). Nuclei were round to ovoid with scant chromatin and variably 0–2 nucleoli. There was anisocytosis and anisokaryosis and occasional multinucleate cells were evident (Figure 2). Mitotic figures were rare, and anisokaryosis characterized by nuclei, varying from pyknotic to large type, variable nuclear to

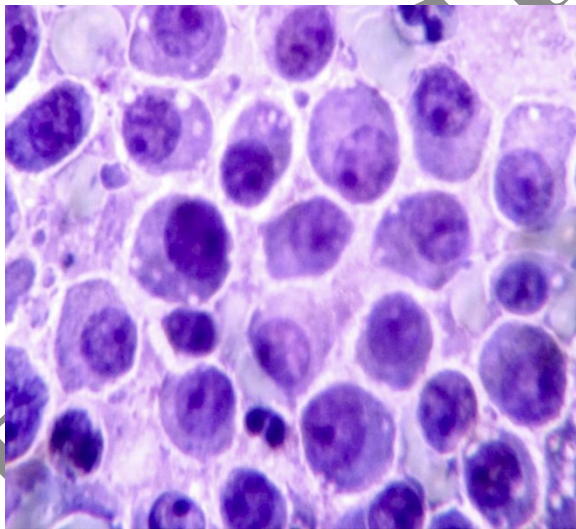


Figure 1 Fine needle aspiration cytology for diagnosis of prepuce SCC. Clustering of large cell populations of malignant tumor, with nuclear anomalies, were identified such as round nuclei in SCC. And also, cytoplasmic vacuolation and a large number of round-shaped germinal cells, with coarse nuclear chromatin and prominent multinucleoli were observed together with vesicular nuclei with prominent nucleoli, May-Grünwald Giemsa (MGG) staining method, 1000x.

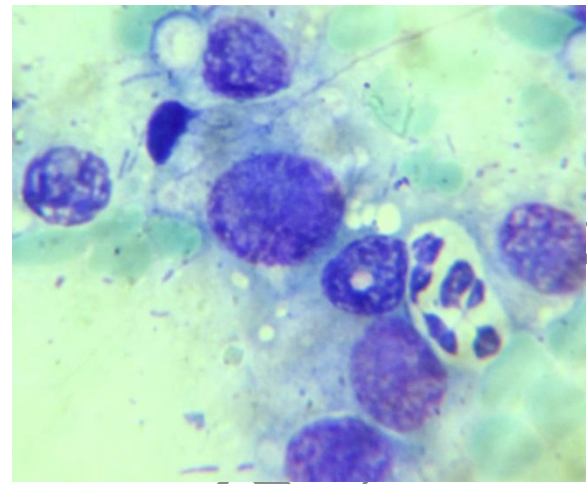


Figure 2 Fine-needle aspiration biopsy. Variation in cell (anisocytosis) and nuclear (anisokaryosis) size are present with abundant chromatin granules and vacuolar changes, May-Grunwald-Giemsa staining method, 1000x.

cytoplasmic ratio, binucleation and multinucleation and perinuclear vacuolation were observed. Cytological smears also revealed a large number of polymorphonuclear and mononuclear cells (Figures 1 and 2).

Histologically, a distinctive microscopic lesion was found in the prepuce of the male dog. Intraepithelial and intra-dermal lesions, with morphological features similar to those previously described, were noted in the prepuce and these lesions occurred in multiple, often noncontiguous, locations along the reproductive tract in this single case. The tumoural plaques appeared as focal hyperplasia of the epidermis covered by increased quantities of keratin. Invasive SCC consist of small aggregates, irregular islands, nests or cords of neoplastic keratinocytes that proliferate downward from the surface (epidermis) and invade the subepithelial stroma of the dermis (Figures 3 and 4). These cells often contained large vacuoles with fine granular basophilic material similar to that present in vacuolated cells of SCC. Frequent findings include keratin formation, horn pearls, mitoses and cellular atypia. Nuclei were oval and had irregular profiles. A high nucleus: cytoplasm ratio, thick nuclear membranes and clumped chromatin are often found. Mitotic figures were occasionally encountered (Figures 4 and 5). In addition, in which the cells had undergone squamous differentiation and keratinization often were present. The degree of nuclear pleomorphism and the mitotic rate varied among the samples (Figure 5). Plasma cells and lymphocytes were often present in the connective tissue adjacent to the epithelium. Squamous differentiation and keratinization of the cells were present multifocally. In the present case, histological evidence of metastasis was scarcely observed.

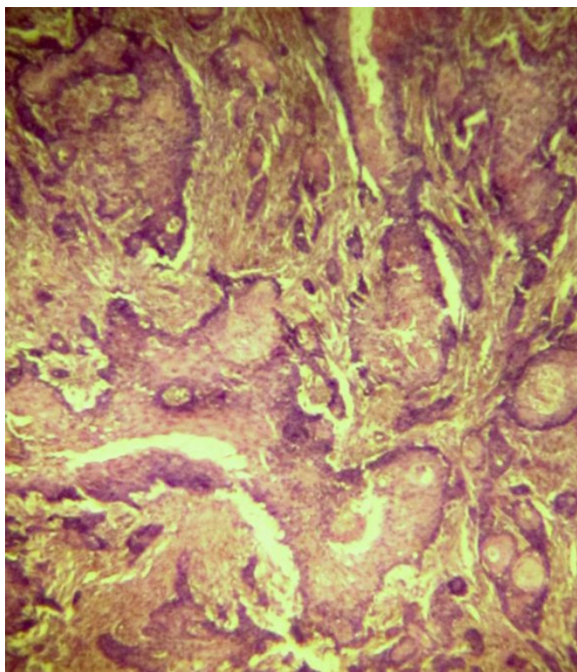


Figure 3 Photomicrograph of the prepuce squamous cell carcinoma in the dog. Hematoxylin/eosin staining showing a non-metastasizing well-differentiated prepuce squamous cell carcinoma. The neoplastic epithelium demonstrates progressive differentiation from a peripheral basal layer with centripetal keratinization. Numerous keratin pearls are present and cellular atypia in all layers of the epidermis, epidermal tissue lying free in the thickness connective tissue (subepidermal) HE. x40.

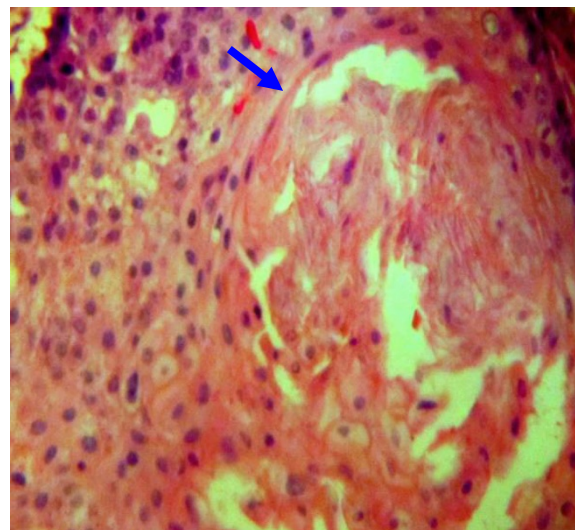


Figure 4 Histologic appearance of well differentiated SCC (H & E). Differentiation of basal cells to keratinocytes is still present. A concentric aggregation of cornfield squamous epithelial cells (Note the prominent keratin pearl formation; blue arrow) is visible with pleomorphism of nuclei, rare mitotic figures and giant nucleus formation and also, the cells had distinct borders, ranged from polygonal to round or elongate, and had moderate amounts of eosinophilic cytoplasm furthermore, the sub-epidermis is focally thickened by large keratinocytes containing increased quantities of pale white cytoplasm that is variably vacuolated HE. x400.

This study was designed to describe and correlate the major clinical and histopathological characteristics of canine genital SCC, similar to that reported in the human literature [24,25]. Cutaneous neoplasms occur in veterinary medicine in distributions similar to those seen in human subjects. Squamous cell carcinoma is the most common tumor seen in the genitalia, accounting for 45% of the tumours seen in the male genitalia and 12% in the female perineum.

Preoperative pathological evaluation of the primary tumour is required to classify the tumour and design a treatment plan. This may be performed by fine needle aspiration biopsy (FNAB) or by punch or excisional biopsy [26,27]. Fine needle aspiration biopsy can be utilized to identify cells with malignant features, but it is not a reliable means of assessing SCC, because early neoplastic, hyperplastic or dysplastic keratinocytes can appear similar cytologically. Tumour architecture and depth of invasion can only be assessed by evaluating a full thickness biopsy; therefore a full thickness biopsy of the lesion is more reliable than FNAB. Independent of the type of tumour, the lesion can be so severe that complete excision is necessary in any case. In such cases, surgical removal or debulking can be combined

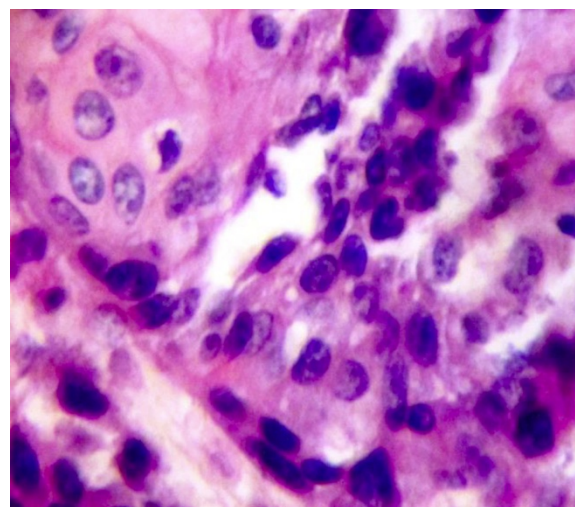


Figure 5 Prepuce; canine squamous cell carcinoma. Nuclei are round to oval with irregular profiles. Moreover, a high nucleus:cytoplasm ratio, thick nuclear membranes and clumped chromatin are often found together with the degree of nuclear pleomorphism and the mitotic rate varied among the sample. Note the arrangement of some large vesicular nuclei into small nests HE. x400.

with harvesting material for histopathological examination. In this study, the malignant squamous cells were pleomorphic, round to caudate in shape exhibiting prominent anisokaryosis and anisocytosis. Anisokaryosis characterised by nuclei, varying from pyknotic to large type, variable nuclear to cytoplasmic ratio, binucleation and multinucleation and perinuclear vacuolation were observed such observations were in line with the previous observations [28-30].

Histologically, the prepuce erythematous plaques (PEP) have been reported to contain mild to moderate epidermal hyperplasia and orthokeratosis [31-33]. In contrast, the epidermis in the presently described plaques was often markedly thickened with prominent folds. While large keratohyaline granules have been previously described in PEP [31,32], the number and size of the granules in the present case was greater than in previous descriptions. The PEP in the presently reported dog underwent malignant transformation more rapidly and more frequently than in previous reports. Additionally, this is the first report of malignant transformation of multiple PEP in a dog without detectable immunodeficiency. Since there are few reports describing the malignant transformation of canine PEP, prediction of which plaques will become neoplastic is difficult. However, results from the present case suggest that larger PEP that contains greater histological changes may be predisposed to malignant transformation. The present dog was anaesthetized to remove ulcerated masses during a 1-day period. Although masses were confirmed histologically to be SCC, all the masses had a similar gross appearance, suggesting that all were likely to be neoplastic. Therefore, the PEP in the presently reported dog underwent malignant transformation more rapidly and more frequently than in previous reports. In the presently reported dog, erythematous plaques frequently and rapidly progressed to SCC within sun-exposed skin. Additionally, although histology revealed only rare foci of koilocytosis, epidermal hyperplasia was prominent, and one section contained bands of keratinocytes with increased quantities of pale cytoplasm and vacuolated nuclei with marginated chromatin within the superficial layers of the epidermis.

In our case most of the lesions were proliferative and were often ulcerated as previously reported in the cutaneous different regions [34]. Ulceration is observed in advanced human SCCs [35] and SCC in human patients usually presents as an indurated, non-healing ulcer [36]. Furthermore, infiltration by lymphocytes has been described in numerous human tumours, the presence of such cell often being associated with an improved prognosis [37-39] that these observations are in agreement with our study. Moreover, the amount of keratin was abundant in our case. The proliferating cells revealed

moderate cellular pleomorphism, large vesicular nuclei, prominent nucleoli and variable mitotic activity. Similar microscopic observations have been reported [40-47].

In conclusion, squamous cell carcinoma can occur on virtually all keratinizing surfaces of the skin. The present study describes for the first time several histological diagnosis of SCC affecting the prepuce of dogs. Although the prognostic value of histological classification of prepuce SCC remains a controversial topic in human medicine, this should be further evaluated in dogs, as there may be differences in the biological behaviour of canine prepuce SCC. The clinical presentation of a well-demarcated scaling erythematous plaque can be altered when it appears in moist, intertriginous, or hyperkeratotic sites. Because little is known about the behaviour of SCC on the external genitalia of the male dog, deciding on the most appropriate treatment is difficult. Poorly differentiated SCC on the external genitalia of the male horse seem to metastasise relatively frequently, but prospective research on the relationship between tumour grade, treatment performed and incidence of recurrence is needed to confirm this clinical impression. So the system proposed in this study, admittedly not based on large case series and entirely open to any modification or improvement, is offered as a first step in this direction.

Conclusions

In conclusion, the presently described case was unusual owing to the extensive development and frequent malignant transformation of the erythematous plaques. To the authors' knowledge, this is the first time that multiple erythematous plaques have undergone malignant transformation in a terrier mix dog. Finally, the histopathologic features coupled with the cytopathology findings led to a diagnosis of squamous cell carcinoma.

Consent

Written informed consent was obtained from the dog owner for publication of this Case report and accompanying images. A copy of the written consent is available for review by the Editor-in-Chief of this journal.

Abbreviations

SCCs: Squamous cell carcinomas; HPV: Herpes papilloma viruses; UV: ultraviolet; HE: Haematoxylin and eosin; MGG: May-Grünwald Giemsa; HPFS: Five high power fields.

Competing interests

The authors declare that they have no competing interests.

Authors' contributions

JYYM, RSH, AMB and MP participated in the histopathological evaluation, performed the literature review, acquired photomicrographs and drafted the manuscript and gave the final histopathological diagnosis and designed and carried out the experiment and, participated in the design of the study. JJ and AM are the principal investigator of the laboratory in which the research was performed and contributed to the interpretation of the data and writing of the manuscript. MP, BP and FKH edited the manuscript and made

required changes and wrote the manuscript. All authors have read and approved the final manuscript.

Acknowledgements

The authors thank Dr.M.aghahammad Hassan for his help with this manuscript.

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Received: 22 April 2014 Accepted: 2 June 2014

Published: 6 June 2014

References

- Schumacher J: Chapter 60 - Penis and Prepuce Equine Surgery (Fourth Edition). *J Am Anim Hosp Assoc* 2012, **44**:840–866.
- Jubb KV, Kennedy PC: *Pathology of Domestic Animals*. vol 1, ed 2nd edition. New York: Academic Press; 1970.
- Keller H: Diseases of male reproductive organs in non-breeding horses. In *Equine Diseases*. Edited by Wintzer HJ. New York: Springer-Verlag; 1986.
- Huang XB, Yu JQ, Zhu XW: [Tumor of the penis—analysis of 300 cases]. *Zhonghua Zhong Liu Za Zhi* 1986, **8**(4):310–311.
- Patnaik AK, Matthiesen DT, Zarvie DA: Two cases of canine penile neoplasm: Squamous cell carcinoma and mesenchymal chondrosarcoma. *J Am Anim Hosp Assoc* 1987, **24**:403–406.
- Kennedy PC, Cullen JM, Edwards JF, Goldschmidt MH, Larsen S, Munson L, Nielsen S: *Histological Classification of Tumors of the Genital System of Domestic Animals*. Washington, D.C: Second Series. IV. WHO, Armed Forces Institute of Pathology; 1998.
- Thuret R, Sun M, Budaus L, Abdollah F, Liberman D, Shariat SF, Iborra F, Guiter J, Patard JJ, Perrotte P, Karakiewicz PI: A population-based analysis of the effect of marital status on overall and cancer-specific mortality in patients with squamous cell carcinoma of the penis. *Cancer Causes Control* 2013, **24**(1):71–79.
- Deem S, Keane T, Bhavsar R, El-Zawahary A, Savage S: Contemporary diagnosis and management of squamous cell carcinoma (SCC) of the penis. *BJU Int* 2011, **108**(9):1378–1392.
- Haeri H, Mardany O, Asadi-Amoli F, Shahsiah R: Human papilloma virus and esophageal squamous cell carcinoma. *Acta Med Iran* 2013, **51**(4):242–245.
- Elango KJ, Suresh A, Erode EM, Subhadra Devi L, Ravindran HK, Iyer SK, Iyer SK, Kurukose MA: Role of human papilloma virus in oral tongue squamous cell carcinoma. *Asian Pac J Cancer Prev* 2011, **12**(4):889–896.
- Van den Top JG, de Heer N, Klein WR, Ensink JM: Penile and preputial tumours in the horse: a retrospective study of 114 affected horses. *Equine Vet J* 2008, **40**(6):528–532.
- Van den Top JG, de Heer N, Klein WR, Ensink JM: Penile and preputial squamous cell carcinoma in the horse: a retrospective study of treatment of 77 affected horses. *Equine Vet J* 2008, **40**(6):533–537.
- Brinsko SP: Neoplasia of the male reproductive tract. *Vet Clin North Am Equine Pract* 1998, **14**(3):517–533.
- Valentine BA: Survey of equine cutaneous neoplasia in the Pacific Northwest. *J Vet Diagn Invest* 2006, **18**(1):123–126.
- May KA, Kuebelbeck KL, Johnson CM: "Urinary bladder rupture secondary to penile and preputial squamous cell carcinoma in a gelding.". *Equine Vet Educ* 2008, **20**(3):135–139.
- Cheville NF: *Cytopathology of viral diseases*. In *Ultrastructural Pathology the Comparative Cellular Basis of Disease*. 2nd edition. Ames, IA: Wiley-Blackwell; 2009:343–346.
- Ginn PE, Mansell JEKL, Rakich PM: **Skin and appendages**. In *Jubb, Kennedy, and Palmer's Pathology of Domestic Animals*. 5th edition. Edited by Maxie MG. Philadelphia, PA: Elsevier; 2007:748–751.
- Gross TL, Ihrke PJ, Walder EJ: *Skin Diseases of the Dog and Cat: Clinical and Histopathologic Diagnosis*. Ames, IA: Blackwell; 2005:567–575.
- Hargis AM, Ginn PE: **The integument**. In *Pathologic Basis of Veterinary Disease*. 4th edition. Edited by McGavin MD, Zachary JF. St. Louis, MO: Elsevier; 2007:1177–1179.
- Nicholls PK, Stanley MA: **The immunology of animal papillomaviruses**. *Vet Immuno Immunopath* 2000, **73**:101–127.
- Radostits OM, Gay CC, Blood DC, Hinchcliff KW: *Veterinary Medicine: A Textbook of the Diseases of Cattle, Sheep, Pigs, Goats, and Horses*. 9th edition. Philadelphia, PA: W.B. Saunders Company; 2000:1244–1248.
- Chernock RD, El-Mofty SK, Thorstad WL, Parvin CA, Lewis JS Jr: **HPV-related nonkeratinizing squamous cell carcinoma of the oropharynx: utility of microscopic features in predicting patient outcome**. *Head Neck Pathol* 2009, **3**(3):186–194.
- Goldschmidt MH, Hendrick MJ: **Tumors of the skin and soft tissues**. In *Tumors in Domestic Animals*. 4th edition. Edited by Meuten DJ. Ames, Iowa: Iowa State Press; Blackwell, Publishing Company; 2002:64–67.
- Pereira TC, Share SM, Magalhães AV, Silverman JF: **Can we tell the site of origin of metastatic squamous cell carcinoma? An immunohistochemical tissue microarray study of 194 cases**. *Appl Immunohistochem Mol Morphol* 2011, **19**(1):10–14.
- Nugent EK, Brooks RA, Barr CD, Case AS, Mutch DG, Massad LS: **Clinical and pathologic features of vulvar intraepithelial neoplasia in premenopausal and postmenopausal women**. *J Low Genit Tract Dis* 2011, **15**(1):15–19.
- Alaa A, Shweta D, Chen M: **Two smalls in one: Coincident small cell carcinoma and small lymphocytic lymphoma in a lymph node diagnosed by fine-needle aspiration biopsy**. *Cytojournal* 2012, **9**:5.
- Sina K, Daniel CA, Elke RA, Alexander NF, Lawrence RM: **A Comparison of Fine-needle Aspiration, Core Biopsy, and Surgical Biopsy in the Diagnosis of Extremity Soft Tissue Masses**. *Clin Orthop Relat Res* 2010, **468**(11):2992–3002.
- Garma AA: **The cytology of squamous cell carcinoma in domestic animals**. *J Vet Diag Invest* 1994, **6**:238–246.
- Henson K: **Reproductive tract**. In *Atlas of Canine and Feline Cytology*. 1st edition. Philadelphia: W.B.Saunders; 2001:277–312.
- Hoffmann D, Spradbrow PG, Wilson BE: **An evaluation of exfoliative cytology in the diagnosis of bovine ocular squamous cell carcinoma**. *J Comp Pathol* 1978, **88**:407–504.
- Antonsson A, Forslund O, Ekberg H, Sterner G, Hansson BG: **The ubiquity and impressive genomic diversity of human skin papillomaviruses suggest a commensalic nature of these viruses**. *J Virol* 2000, **74**(24):11636–11641.
- Longworth MS, Laimins LA: **Pathogenesis of human papillomaviruses in differentiating epithelia**. *Microbiol Mol Biol Rev* 2004, **68**(2):362–372.
- Munday JS, Peters-Kennedy J: **Consistent detection of Felis domesticus papillomavirus 2 DNA sequences within feline viral plaques**. *J Vet Diagn Invest* 2010, **22**(6):946–949.
- Evans SM, Shofer F: **Canine oral nontonsillar squamous cell carcinoma**. *J Am Vet Med Assoc* 1988, **192**:933–936.
- Barnes L, Eveson JW, Reichart P, Sidransky D: *Pathology and Genetics of Head and Neck Tumours*. World Health Organization Classification of Tumours. Lyon: IARC Press; 2005.
- Regezi JA, Dekker NP, Ramos DM, Li X, Macabeo-Ong M, Jordan RC: **Proliferation and invasion factors in HIV-associated dysplastic and nondysplastic oral warts and in oral squamous cell carcinoma: an immunohistochemical and RT-PCR evaluation**. *Oral Surg Oral Med Oral Pathol Oral Radiol Endod* 2002, **94**(6):724–731.
- Schumacher K, Haensch W, Röefzaad C, Schlag PM: **Prognostic significance of activated CD8 (+) T cell infiltrations within esophageal carcinomas**. *Cancer Res* 2001, **61**(10):3932–3936.
- Ryschich E, Nötzel T, Hinze U, Autschbach F, Ferguson J, Simon I, Weitz J, Fröhlich B, Klar E, Büchler MW, Schmidt J: **Control of T-cell-mediated immune response by HLA class I in human pancreatic carcinoma**. *Clin Cancer Res* 2005, **11**(2 Pt 1):498–504.
- Ohtani S, Iwamaru A, Deng W, Ueda K, Wu G, Jayachandran G, Kondo S, Atkinson EN, Minna JD, Roth JA, Ji L: **Tumor suppressor 101F6 and acerbated synergistically and selectively inhibit non-small cell lung cancer growth by caspase-independent apoptosis and autophagy**. *Cancer Res* 2007, **67**(13):6293–6303.

40. Esplin DG, Wilson SR, Hullinger GA: **Squamous Cell Carcinoma of the Anal Sac in Five Dogs.** *Vet Pathol* 2003, **40**:332.
41. Lascelles BDX, Parry AT, Stidworthy MF, Dobson JM, White RAS: **Squamous cell carcinoma of the nasal planum in 17 dogs.** *Vet Rec* 2000, **147**:473–476.
42. Maiolino PB, Restuccia S, Papparella A, Vicob GD: **Nuclear Morphometry in Squamous Cell Carcinomas of Canine Skin.** *J Comp Pathol* 2002, **127**(2–3):114–117.
43. Viswanath S, Vijayasarithi SK, Sreenivas RN, Suguna RAO: **Pathology of canine oral neoplasms.** *Indian J Vet Pathol* 1998, **22**:150–153.
44. Javanbakht J, Tavassoli A, Sasani F, Sabbagh A, Hassan MA, Samakkhah SA, Shafiee R, Jani M, Alimohammadi S, Samani R, Barati F, Ghalee VR: **An overall assessment of circumanal gland adenoma in a terrier mix breed dog.** *Asian Pac J Trop Biomed* 2013, **3**(7):580–583.
45. Javanbakht J, Tavassoli A, Sabbagh A, Hassan MA, Samakkhah SA, Shafiee R, Lakzian A, Ghalee VR, Gharebagh SS: **Evaluation of an anal sac adenocarcinoma tumor in a Spitz dog.** *Asian Pac J Trop Biomed* 2013, **3**(1):74–78.
46. Tavasoly A, Javanbakht J, Khaki F, Hosseini E, Bahrani A, Hassan MA, Mirabad M: **Ulnar malignant peripheral nerve sheath tumour diagnosis in a mixed-breed dog as a model to study human: histologic, immunohistochemical, and clinicopathologic study.** *Diagn Pathol* 2013, **8**:86.
47. Khaki F, Javanbakht J, Sharifzad S, Gharagozlou MJ, Khadivar F, Manesh JY, Hosseini SH, Anissian A, Touni SR, Gilvari A, Abdi FS: **Metastatic ovarian papillary cystadenocarcinoma to the small intestine serous surface: report of a case of high-grade histopathologic malignancy.** *J Ovarian Res* 2014, **7**(1):33.

doi:10.1186/1746-1596-9-110

Cite this article as: Yaghoobi Yeganeh Manesh *et al.*: Cytohistopathological and outcome features of the prepuce squamous cell carcinoma of a mixed breed dog. *Diagnostic Pathology* 2014 **9**:110.

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