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Original Article

# Surgical Treatment and Relative Frequency of Skin Tumors in Domestic Equids: A Retrospective Study

Farid Yadollahi[1], Saeed Azizi[1]*, Ali-Asghar Tehrani[2]

*[1] Department of Surgery and Diagnostic Imaging, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran. [2] Department of Pathobiology, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran.*

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**ABSTRACT**

The purposes of the present study were to report the relative frequency, to compare skin neoplastic diseases diagnosed in horses, donkeys, and mules in a referral hospital population, and to evaluate the outcome of surgical intervention in the treatment of the skin neoplastic diseases in the domestic equids. Seventy-two domestic equids including 32 horses, 30 mules, and 10 donkeys were included in this retrospective study. Data were obtained from medical sheets. The relative frequency of skin tumors was determined. The abnormal skin neoplastic/hyperplastic masses were removed with a radical surgical excision. The diagnosis was based on signalment, history, gross clinical examination, and confirmed by histopathological examination. The outcomes of surgical intervention were evaluated. The occurrence of skin tumors was higher in males than females and higher in intact males than geldings. Sarcoids were the most common skin tumor of horses and mules. Squamous cell carcinoma (SCC) was the second most common skin tumor in horses, whereas, papilloma/fibropapiloma was the second most common skin tumor in mules. Both sarcoids and SCCs were the most common skin tumors in donkeys. The inguinal region was the main anatomic location for the occurrence of skin tumors in males especially in intact, equids. Sarcoids were mainly diagnosed on the skin of the male external genital system in intact horses. In male mules, all diagnosed sarcoids were located on the skin of the external genital system. Histopathological examination is necessary for accurate diagnosis of the skin neoplastic and non-neoplastic lesions in the equids. The skin of the male external genital system is the main predilection site for the occurrence of skin tumors in domestic equids. It seems that conventional surgery as a practical technique offers a higher rate of success in the treatment of skin tumors in domestic equids.

## Introduction

The integrity and health of skin can be impacted by trauma, infections and neoplastic conditions. The skin lesions include neoplastic or non-neoplastic conditions. The types of skin tumors may have different clinical manifestations. The majority of equine skin diseases requiring a surgical intervention are of neoplastic

* Correspondence to: Saeed Azizi; Department of Surgery and Diagnostic Imaging, Faculty of Veterinary Medicine, Urmia University, Urmia, Iran. Email: s.azizi@urmia.ac.ir



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origin.[1] Skin cancers are relatively common in horses.[2] They are most frequently the leading cause of discomfort and illness and may progress to more severe sequelae and even result in death.[3]

The occurrence of skin tumors may vary depending on the breed, age and sex in horses. Sarcoid is the most common skin tumor, squamous cell carcinoma is the second most common skin tumor and equine melanoma is a frequent skin tumor in horses.[1] Equine cutaneous mastocytosis, papillomatosis, fibromas, fibrosarcomas and external lipomas are a relatively rare or less common neoplasia of skin in horses.[1,4]

The global population of donkeys (*Equus asinus*) and mules is estimated to be 44 and 11 million, respectively. Almost all of them are used as labor animals.[5] The skin neoplasia affecting this group of equids is largely unknown. There is few information available regarding cutaneous tumors affecting donkeys,[6] and the literature lacks the definite review of neoplastic skin diseases in mules. Moreover, the review studies of equids show that there are limited individual cases of skin tumors in mules.

Appropriate identification, diagnosis and treatment of skin neoplastic conditions are particularly imperative to achieve favorable outcome of the treatment. The chance of tumor recurrence, local invasion or metastasis may increase with an improper diagnosis or inexperienced treatment. The purposes of the present study were to report the relative frequency and to draw comparisons of neoplastic diseases diagnosed in horses, donkeys and mules in a referral hospital population. Also, the outcome of surgical intervention in treatment of the skin neoplastic diseases in the affected horses, donkeys and mules were evaluated.

## Materials and Methods

A total number of 72 domestic equids including 32 horses, 30 mules and 10 donkeys were referred to the Teaching Hospital of Faculty of Veterinary Medicine, Urmia University, Urmia Iran, to distinguish the abnormal masses/lesions of skin between September, 2001 and March 2019. The relative frequency of skin tumors in the hospital was determined in this retrospective study. Also, the results of surgical interventions and outcomes were evaluated. Diagnosis of tumors were based on the history, clinical examination and gross appearance of each mass/lesion confirmed by histopathological examination.

### *Clinical Inspection*

In each animal, routine clinical examinations were performed and the skin abnormal masses/lesions were examined grossly following thorough history taking. Plain radiography and/or ultrasonographic examination and regional lymph nodes examination, rectal palpation and chest radiography were sometimes used to assess the possibility of metastasis. Ultrasonography were used to determine the precise nature of the subcutaneous complicated structures. The signalment information, patient history, breed, age, purpose of use, gender, sex status: castrated/intact, anatomic location, gross description and ancillary tests were documented in the medical record sheets for each case. The anatomic locations of tumors were grouped as follow: Head including face, ears, lips, periocular (lower palpebra), maxilla and mandible; inguinal region including prepuce, penis, scrotum and teat area; limbs and trunk including neck, shoulder, pectoral area, ventrum, high/low flank and caudal abdomen. The abnormal mass and lesions representing a hyperplastic or neoplastic appearance were subjected to a radical surgical excision. Biopsy specimens were taken when the owner not satisfied due to the cost for surgery.

### *Anesthesia and Surgical Techniques*

The surgical procedure and biopsy specimen were taken under general anesthesia in lateral and/or dorsal recumbency or under sedation with local anesthesia on standing position. Feed withdrawal time were 12-16 hours, if needed. The animals were sedated using a combination of xylazine hydrochloride (0.2 mg/kg, IV, Alfasan, Woerden, Netherlands) and acepromazine maleate (0.02 mg/kg, IV, Neurotranq, Alfasan, Woerden, Netherlands) via jugular vein. The animals received penicillin G/procaine (22,000 IU/kg, IM) and gentamicin sulfate (2.2 mg/kg, IV, Aburaihan Pharmaceutical Co., Tehran, Iran) or dihydrostreptomycin sulfate (10 mg/kg, IM, Nasr Pharmaceutical Co., Mashhad, Iran) as pre-surgical antimicrobial agents three hours before surgery. Induction of general anesthesia was done using an IV cocktail of ketamine 2.2 mg/kg and xylazine 1.1mg/kg or with 10% thiopental sodium (7 mg/kg IV, Pentothal, Ceva Laboratories, France). Following endotracheal intubation, anesthesia was maintained on halothane or isoflurane (1.50–2%, AErrance, Baxter Healthcare, Puerto Rico) via oxygen.

The surgical field were prepared for aseptic surgery following clipping and draping with sterile cloths. The skin incision was done on the apparent healthy normal tissue by a scalpel blade. Using sharp and blunt dissection the entire affected abnormal tissues were removed using scissors, Burdizzo castration forceps or Ecraseur Chassaignae depending on the size of mass followed by coagulation with electrocautery and ligation. The biopsy samples were taken by a 7 mm biopsy punch or scalpel blade enclosing normal and abnormal tissue. In standing sedation, biopsies were collected after subcutaneous infiltration of 2% lidocaine adjacent to the skin growths/lesions. Surgical modalities included local excision, castration, partial phallectomy and preputial resection. The surgically created skin loss and/or soft tissue failure were subjected to the one of primary closure or second intention healing processes.

### *Postoperative Care*

The animals received post-operative antibiotics, anti-inflammatory and local wound care. The preoperative antibiotic; penicillin G/procaine (22,000 IU/kg, IM q 12 h), gentamicin sulfate (2.2 mg/kg, IV q 8 h), or dihydrostreptomycin sulfate (10 mg/kg, IM q 12 h) were continued for 3-5 consecutive days after surgery. The animals received phenylbutazone (2.2 mg/kg, IV) or flunixin meglumine (1.1 mg/kg, IV/IM q 12 h) to control pain for 3-5 consecutive days postoperatively. Also, they received a single dose of vitamin $AD_3E$/$AD_3EC$ compound intramuscularly. Postoperative local wound care recommendations included daily inspection and cleaning, lavage and dressing or covering the wound by a spray of antibiotic/disinfectant with/without insect repellent for 5-14 days, as indicated. The animals were confined to a stall for 5-7 days and then hand walking. Return to previous services were allowed in a gradual manner within a month. The skin sutures were usually removed on 14 days after surgery. Follow-up for the possibility of recurrence of the tumors was done within 6 to 24 months after surgery.

### *Histopathological Examination*

The detailed clinical gross findings of the tumorous growths/lesions were recorded. The harvested tissue samples from the excised mass were fixed in neutral buffered formalin 10%. The specimens were sectioned into small slices with thickness of 2–3 mm and embedded in the paraffin by standard procedures. The embedded tissues were cut into 5 µm thick, stained with hematoxylin and eosin and observed under light microscopy.[7]

## Results

A total number of seventy-two samples were examined histologically to distinguish skin neoplasia conditions in the equids. Based on the histopathological examination, skin tumors diagnosed in 62 cases included 27 horses, 25 mules, and 10 donkeys. The relative frequency of skin neoplasia in horses and mules were 84% (27 tumors out of 32 samples) and was 83% (25 tumors out of 30 samples), respectively. All of the skin samples (No. 10) were neoplastic in the affected donkeys.

The mean age of the horses affected with cutaneous tumors were 7 years, with a range of 2 to 12 years. The mean age of the mules were 6 years, with a range of 3 to 12 years. The mean age of the donkeys were 6 years, with a range of 3 to 7 years. The horses were used for riding or for labor, 52% vs. 48%. However, the mules and donkeys were mainly used for labor. The mules were basically used for carrying goods and heavy load across narrow passages of mountain and the donkeys were always used as a pack animal for shepherd in sheep flocks.

The relative frequency of the type of skin tumors in relation to sex status and gender of the equids is represented in Table 1. In general, the occurrence of skin tumors in the horses were higher in males than females (96% vs. 4%) and higher in intact than geldings (82% vs. 18%). The most common tumor of horses was sarcoid (29%) followed by SCC (22%). The occurrence of skin tumors in the mules were higher in males than females (76% vs. 24%) and higher in intact than geldings (84% vs. 16%). The most common tumor of mules were sarcoids (40%) (Figure 1) followed by papilloma/fibropapiloma (28%). Both of sarcoids and SCCs with a relative frequency of each 30%, were the most common skin tumors of donkeys.

Table 2 represents the anatomical location of the different types of skin tumors in relation to sex status, gender, species and different breeds of the horse. Inguinal region was the main anatomic location for the occurrence of skin tumors in the males, especially intact equids. However, the occurrence of inguinal skin tumors in geldings was infrequent. Sarcoids were mainly diagnosed on the skin of the male external genital system in the intact horses (62%). Squamous cell carcinoma was the most common glans/penis

tumor of the male horses. In one horse, sarcoids were developed on the skin of prepuce, pectoral region and fetlock of hind limb simultaneously. Squamous cell carcinoma developed on the skin of periocular region (lower eyelid) in a horse (Figure 2). In mules all diagnosed sarcoids were on the skin of male external genital system.

Fibrosarcomas were diagnosed on the lower lip of a 7 year-old mare, the digit of left hind limb of a 3 year-old stallion (Figure 3), the pectoral region of a 11 year-old stallion and the skin of prepuce of a 5 year-old gelding representing 15% of the skin neoplastic conditions in the affected horses. Three fibromas were diagnosed in the present study. The fibromas were located on the elbow of an 8-year-old stallion, the dorsum of tarsus of a 2-year-old stallion and the plantar aspect of metatarsus of a 7-year-old stallion. Also, three fibromas were diagnosed in the mules were located on the perineal region of a 4-year-old intact male, the skin of prepuce of a 6-year-old intact mule and the dorsal aspect of tarsus of a 7-year-old intact mule. Fibromas were diagnosed in two donkeys and both were located on the skin of prepuce of the intact jacks. Less frequent skin tumors of mules were hemangiosarcoma and melanocytoma (Figure 4) that located on the medial aspect of tibia of a 4-year-old mare and the ventral aspect of radius of a 9-year-old mare.

The clinical appearances of some lesions resembled to the neoplastic conditions; however, they were diagnosed to be a non-neoplastic based on the histopathological examination. Accordingly, two kinds of non-neoplastic lesions were diagnosed in four horses with hyperplastic proud flesh tissue. Exuberant granulation tissue diagnosed in four of the horses with proud flesh tissue were located on the pastern of hind limb, dorsum of fetlock of hind limb, dorsum of metacarpal of forelimb, and dorsum of metatarsal of hind limb. In the fourth horse which had a tumor-like mass located inside the scrotal skin, a granulomatous purulent inflammatory tissue was diagnosed. It was sequel to a previously performed castration.

Furthermore, non-neoplastic condition of the skin was diagnosed on histopathological examination in five mules with the tumor-like masses. In two cases, in one with a history of non-surgically castration, a large tissue mass was located on the skin of scrotum and prepuce and in the second, a mass was located on the medial thigh, both of them were diagnosed as an exuberant granulation tissue formation. In third case, a hyperplastic proud flesh tissue located on the dorsum of tarsal region was diagnosed as excessive connective tissue which resembled to a keloid tissue. In the fourth and fifth cases, proliferative ulcerated lesions were located on the skin of prepuce and diagnosed as cutaneous habronemiasis, histopathologically. Overall, non-neoplastic lesions should be considered in

***Table 1.*** The relative frequency and the distribution of the types of skin tumors in the domestic equids.

| Species | Breed | Gender | | Sex status | | Type of the skin tumor | | | | | | | | | | | Riding | Labor |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Male | Female | Intact | Gelding | Sarcoid | Fibroma | FS | HGS | VHR | SCC | papilloma | FP | AM | Melanoma | MC | | |
| Horse | Kurd | 17 | 1 | 14 | 4 | 6 | 3 | 3 | | 1 | 4 | 0 | 0 | 1 | 0 | 0 | 11 | 7 |
| | Persian Arab | 8 | 0 | 8 | 0 | 2 | 0 | 0 | 0 | 0 | 2 | 2 | 1 | 0 | 1 | 0 | 2 | 6 |
| | Oldenburg | 1 | 0 | 1 | 0 | 0 | 0 | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 |
| | Total Number | 26 | 1 | 23 | 4 | 8 | 3 | 4 | 0 | 1 | 6 | 2 | 1 | 1 | 1 | 0 | 14 | 13 |
| **Relative frequency (%)** | | 96 | 4 | 82 | 18 | 29 | 11 | 15 | 0 | 4 | 22 | 7 | 4 | 4 | 4 | 0 | 52 | 48 |
| **Mule** | | 19 | 6 | 16 | 3 | 10 | 3 | 0 | 1 | 0 | 3 | 4 | 3 | 0 | 0 | 1 | 0 | 25 |
| **Relative frequency (%)** | | 76 | 24 | 84 | 16 | 40 | 12 | 0 | 4 | 0 | 12 | 16 | 12 | 0 | 0 | 4 | 0 | 100 |
| **Donkey** | | 10 | 0 | 10 | 0 | 3 | 2 | 0 | 0 | 0 | 3 | 1 | 1 | 0 | 0 | 0 | 0 | 10 |
| **Relative frequency (%)** | | 100 | 0 | 100 | 0 | 30 | 20 | 0 | 0 | 0 | 30 | 10 | 10 | 0 | 0 | 0 | 0 | 100 |
| **Total number** | | 55 | 7 | 49 | 8 | 21 | 8 | 4 | 1 | 1 | 12 | 7 | 5 | 1 | 1 | 1 | 14 | 48 |
| **Relative frequency (%)** | | 89 | 11 | 86 | 14 | 34 | 13 | 6 | 2 | 2 | 19 | 11 | 8 | 2 | 2 | 2 | 23 | 77 |

Abbreviations: Fibrosarcoma (FS), Hemangiosarcoma (HGS), Vascular hamartoma (VHR), Squamous cell carcinomas (SCC), Fibropapiloma (FP), Amelanotic melanoma (AM), Melanocytoma (MC).

***Table 2.*** The anatomical location of the different types of skin tumors in relation to sex status, gender, species and different breeds of the horse.

| Species | Gender | Sex status (No.) | Inguinal Region | | Limbs (No.) | Trunk | | Head |
|---|---|---|---|---|---|---|---|---|
| | | | Penis/ Glans (No.) | Prepuce/ Scrotum (No.) | | Thorax/Pectoral/ Ventrum (No) | Neck (No.) | Lower eyelid (No.) Face/Lower lip (No.) |
| Horse | Male | Intact 23 | Squamous cell carcinoma (4) Papilloma (1) Sarcoid (1) | Sarcoid (4) Papilloma (1) Fibropapiloma (1) | Sarcoid (1) Fibroma (3) Fibrosarcoma (1) Benign Melanoma (1) | Sarcoid (1) *pectoral region* Sarcoid (1) *ventrum* | Fibropapiloma (1) | Squamous cell carcinoma (2) *Lower eyelid* |
| | | Gelding 3 | | Fibrosarcoma (1) | Vascular Hamartoma (1) | | Amelanotic melanoma (1) | |
| | Female | 1 | | | | | | Fibrosarcoma (1) *Lower lip* |
| Mule | Male | Intact 16 | Sarcoid (1) | Sarcoid (4) Squamous cell carcinoma (2) Fibroma (2) Papilloma (4) Fibropapiloma (1) | Fibroma (1) | Fibropapiloma (1) *Thorax* | | |
| | | Gelding 3 | | Sarcoid (2) Squamous cell carcinoma (1) | | | | |
| | Female | 6 | | | Hemangiosarcoma (1) Sarcoid (1) Fibropapiloma (1) Melanocytoma (1) | | | Sarcoid (1) *Lower eyelid* Sarcoid (1) *Face* |
| Donkey | Male | Intact 10 | | Squamous cell carcinoma (2) Sarcoid (2) Papilloma (1) Fibropapiloma (1) Fibroma (2) | Sarcoid (1) | | | Squamous cell carcinoma (1) *Face/Nose* |

differential diagnosis of skin tumors. Hence, they could encompass 12.5% of the skin condition in the domestic equids.

### *Surgical Outcomes*

All animals were safely recovered from anesthesia and discharged from the hospital after 4-6 hours. Surgery was successful, in short term, in removing of a malignant (anaplastic) amelanotic melanoma in a grey Kurdish gelding. However, the tumor recurred in the six months post operation and finally the horse was candidate of euthanasia. One aged gelding mule was euthanized demanded by owner due to developing of SCC on the scrotum, prepuce and entire ventrum. Surgery was effective in removing of a SCC tumor developing on the face and dorsal turbinate air way of nose, however, the affected jack died four days later with unrecognized pathology. There were no any claims for recurrence of the surgically removed skin tumors on the follow-up period for the rest of the equids.

## Discussion

In the present study the relative frequency of skin neoplasia in horses, mules and donkeys were studied. The most common skin tumor for the all studied equids were sarcoids. The result of the present study was in agreement with the results of other studies which indicated that sarcoid was the most common cutaneous tumor in the equids.[2,8-10] The relative frequency of sarcoids among the skin tumors in the horses was 28%

in the present study. Sarcoids are the most common skin neoplasm of horses, with reported prevalence rates ranging from 12.9 to 90% of tumors.[4,8,10]

Sarcoids are locally aggressive, non-metastatic fibroblastic skin tumor that is reported in horses, mules, donkeys and zebras.[4,8] In the horses, sarcoids occur in any breed, sex or age. Breed predilection is reported for Appaloosas, Quarter Horses, Arabians and Thoroughbreds, and in a lower incidence in Standardbreds and Lipizzaners.[2,4] In the present study the relative frequency of the sarcoid in Kurd and Persian Arab horses were 23% and 8%, respectively. Sarcoids can develop anywhere on the body, however, they are most commonly localized on the head, legs, ventral trunk[4] and the paragenital region.[8,11] In the present study the sarcoids were developed on head, limb, pectoral region and ventrum, however, they were more common on the skin of prepuce and scrotum (62%) in intact horses which was contrary to the result of Brinsko.[12] Brinsko reported that penis was rarely affected which was is in agreement with our results. In our study sarcoids were observed on the dorsum of the trunk which was in agreement with Knottenbelt *et al.*[13] that reported the least common occurrence of the tumor on the region.

Young horses of 1-7 years of age are at increased risk of sarcoids with rare reports in older horses.[4] In the present study, sarcoids were most commonly occurred in young adult horses of 3-8 years (mean 6) of age. The mean age of equine sarcoids are reported varying from 3.5 to 4 years,[8] to 9 years.[2] In general, it could be concluded that horses among 3 - 12 years of age might be at high risk with equine sarcoids. Sarcoids frequently develop in areas subjected to trauma or at sites of wounds 6-8 months after wound healing.[4,8] In the present study, 5 out of 8 horses with sarcoids had a history of previous trauma 2-6 months earlier at the site of skin injury.

In the present study, the relative frequency of skin neoplasia in mules was 83%. The available literature lacks documents regarding the prevalence/incidence of skin tumors in mules. In the present study, the occurrence of skin tumors was higher in male mules than females (76% vs. 24%). Because all them were used for labor and generally males are more favored than females in this purpose. Also, intact male mules might be at higher risk to develop skin tumors because a higher occurrence of skin tumors were diagnosed in intact animals compared to geldings (84% vs. 16%).

The relative frequency of sarcoids was 40% among the skin tumors in mules. Also, almost always diagnosed skin tumors developed on the male external genital system. In one mule, sarcoids developed on the

***Figure 1.*** Sarcoid developed on the skin of a female mule, below the lower eyelid.

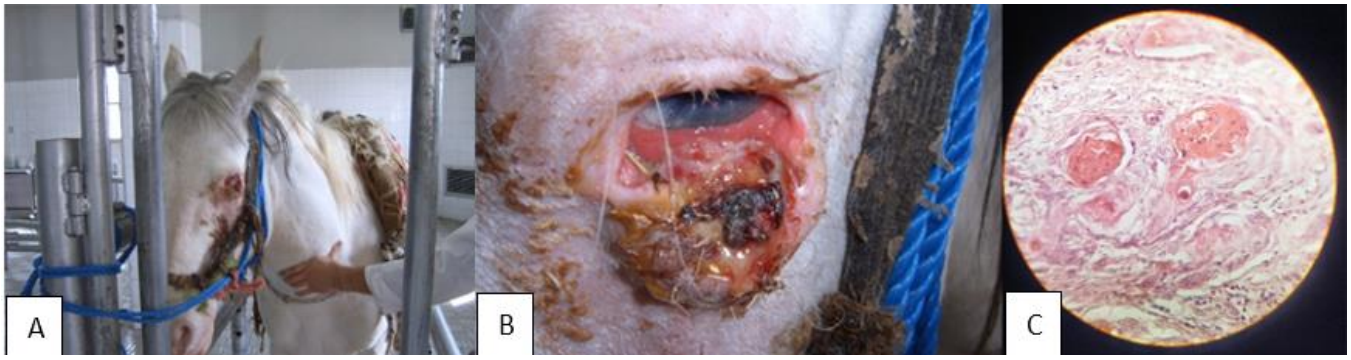


***Figure 2.*** A and B: Squamous cell carcinoma developed on the skin of periocular region (lower eyelid) in a horse. C: Well differentiated squamous cell carcinoma shows large malignant cells with variable keratinization (40×, H&E).

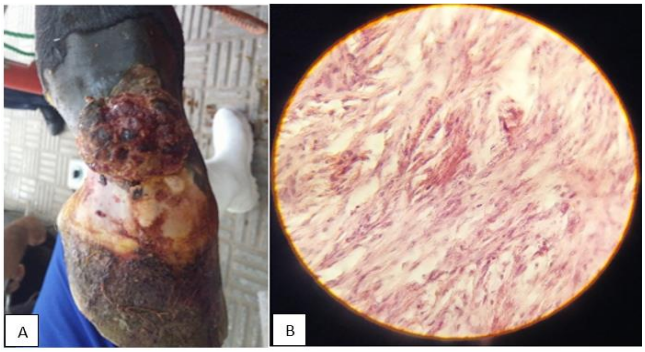


***Figure 3.*** A: Fibrosarcoma on the digit of left hind limb of a 3-years-old stallion. B: Highly cellular fibroblastic proliferation with variable collagen. Cells bear elongated dark nuclei, and mitotic activity is present, (40×, H&E).

skin of both prepuce and ventrum, and in another mule it was developed on the skin of face, fore limb and hind limb, simultaneously. There is no any study to determine breeds of mules yet. Like horses, it seems sarcoids affect young adult mules because the mean of age of the animals was 7 years (ranging 5-12). In contrast to the sarcoids in horses, a history of previous trauma at the site of skin injury was not observed. It could be speculated that trauma and skin injury may not predispose development of sarcoids in the mules.

Unlike the horses and mules, all of the submitted skin samples (No. 10) for histopathological examinations were neoplastic in donkeys in the present study. Therefore, the aforementioned non-neoplastic condition of the skin in donkeys might be rare. In the present study like horses, sarcoids in donkeys were the most common tumor, accounting for 30% of cutaneous tumors and this was in agreement with the results of Davis *et al*.[6] Like horses and mules, the average age of diagnosis was six years of age (ranging 5 to 7) in donkeys. It seems sarcoids affect young adult donkeys which was in agreement with the results of Davis *et al*.[6] The majority of sarcoids were developed on the skin of prepuce that was contrary to the results of Davis *et al*.[6] that reported the majority of sarcoids were developed on the head. Davis *et al.*[6] reported that sarcoids were frequently located on the groin regions in male donkeys that was in agreement with our results. Since all of donkeys were used for labor, and generally males are more favored than females for this purpose, there was no any diagnosed skin tumors in females. In the present study, 2 out of 3 donkeys with sarcoids had a history of previous trauma 2 months earlier, at the site of skin injury.

Both surgical and non-surgical techniques have been described for sarcoids treatment. Meanwhile none of the current applied techniques has been approved to be successful.[14] Spontaneous tumor regression has been reported in 48% of the affected horses.[15] Surgical excision of equine sarcoids has been applied for decades with variable success rates.[16,17] Conventional surgical excision without adjunctive therapy has been reported to be one of the least successful treatment options with a recurrence rate of 15.8 to 82 percent.[1,4,16] However, surgical excision was the first and final available choice in treatment of sarcoid in the present study. Extended surgical excision was performed on the normal skin margins (at least 15 mm) to remove any lesion. Also, to improve the chance of success rate of surgery, a strict technique of non-touch with copious lavage was applied. Fortunately, no recurrence was observed for sarcoids in the all surgically treated equids.

Squamous cell carcinoma is a relatively common, locally invasive and occasionally metastatic neoplasm of most domestic species.[4] In the present study, SCC was the second most common skin tumor (22%) of

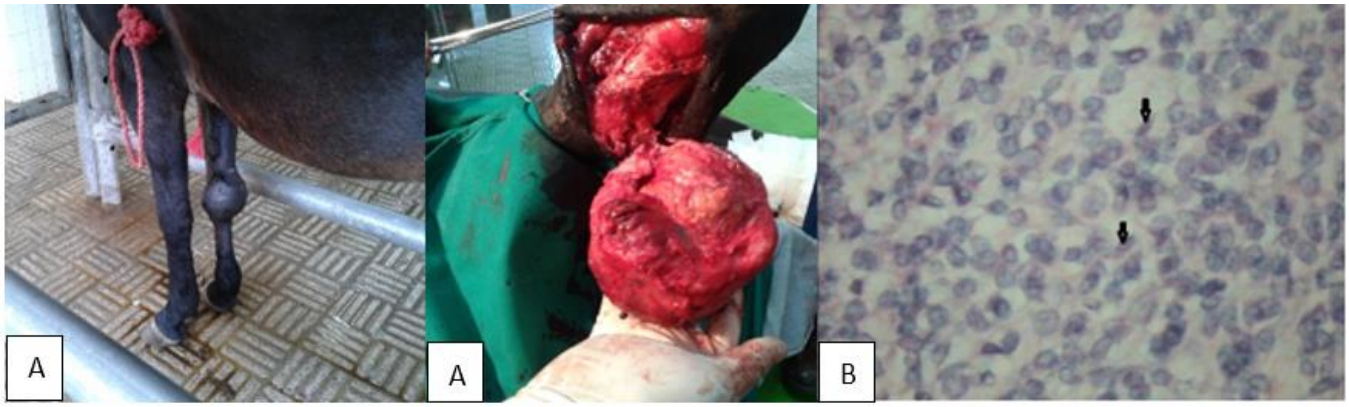


***Figure 4.*** A: Melanocytoma on the ventral aspect of radius skin in a 9-years-old mare mule. B: Sheet of uniform cells composed of spindle cells (arrows) are intermixed with cells with epithelial feature. The cells are relatively large with higher nuclei to cytoplasmic ratio (100×, H&E).

adult horses (mean age of 8) which was in agreement with the findings of other studies.[12,18,19] The predilection sites for development of SCCs are the periocular region, penis, and perianal regions.[4] In the present study, glans/penis was the main site of developing SCCs in the affected horses with a rate of 67%, that was in agreement with the Brinsko findings which indicated penis, prepuce, or both as the commonest locations for SCCs.[12] Surgical excision as the sole method should be reserved for small tumors and when combined with adjunctive therapies better success rate is ensued.[1] However, no recurrence was seen following extended surgical excision of the tumors in the treated animals in our study. In the present study, SCC was not relatively common skin tumor (12%) in mules. We could not find a previous skin injury, trauma and inflammation at the tumor sites in history of the affected animals, however, there are few case reports which shows SCCs can develop in areas of chronic, poorly healing wounds and at sites of previous burn injury.[1,4]

In the present study, the typical cutaneous papilloma, wart-like and fibropapilloma were not too prevalent in the horses. However, in the mules, the rate of papilloma and fibropapilloma were 16% and 12%, respectively. In a study of 12 skin tumors, it was reported that fibropapilloma was a less frequent skin tumor in mules.[20] In the present study, prepuce was the main site of developing of papilloma, 4 out of 5 papillomas, in the affected mules. Surgery was successful in treatment and no recurrence was seen on the fallow-up period.

Fibrosarcomas are malignant tumors of fibroblasts.[4] It is unusual mesenchymal tumor in male genitalia of horse.[12,21] It has been reported that fibrosarcomas also tended to recur after excision[1,4] however, in the present study no recurrence was observed with radical excision of the tumors. Fibrosarcomas were not diagnosed in mules and donkeys in the present study.

Fibromas are uncommon benign tumors of fibroblasts and collagen that occur in adult and aged animals of all species.[4] Low prevalence of 2.1-2.4% were reported for soft-tissue fibromas in horses[6] and the relative frequency for fibroma were 11% in horses in the present study with more predilection site on the limbs. Three fibromas were diagnosed in the intact mules in our study. There is one report of fibroma located on thigh in a 2-year-old female mule.[22] In the present study fibromas were diagnosed in two donkeys. Reportedly, fibromas are uncommon (2.4%) in donkeys.[6] The success of surgical excision without adjunctive therapies is poor for treatment of fibromas,[1] however, all affected equids responded well to surgical removal of the tumors in our study. There was no evidence of the recurrence of the tumors on the follow-up period in all surgically treated cases.

In the present study, less frequent skin tumors of horses were vascular hamartoma, amelanotic melanoma and benign melanoma. One vascular hamartoma was located on the dorsal aspect of the left metatarsus of a 5-year-old gelding,[23] one anaplastic malignant amelanotic melanoma on the right lateral of the neck of an 11-year-old gelding,[24] and one benign melanoma on the tarsus of a 12-year-old gray stallion. Histopathologic findings show that melanomas include 4 to 15 percent of all skin tumors.[1] This was in agreement with our results. There was no evidence of recurrence for the surgically treated benign melanoma on the follow-up period in the affected horse. However, the malignant form of melanoma recurred in a 6-month later that was described in our previous report.[24] A higher recurrence rate of malignant melanomas using simple excision has been reported.[1] No recurrence was observed following radical excision of a hemangiosarcoma and a melanocytoma tumor in surgically treated mules.

Occasionally, the gross appearance of some chronic inflammatory lesions such as bacterial and fungal granulomas, exuberant granulation tissue, and cutaneous habronemiasis might mimic papillomas, sarcoids, squamous cell carcinoma and other tumors. Reviews have shown that, history taking, clinical examinations are two important aspects for a successful preliminary tentative diagnosis of the skin lesions. However, histopathology examinations are necessary for definitive diagnosis of a skin neoplastic and non-neoplastic lesions in the equids. In the present study, the skin of external genital system, the prepuce, penis/glans and scrotum included half of skin tumors (13 out of 26 cases) for the tumor occurrence in the male horses. In the mules, more than 94% of skin tumors were located (18 out of 19 cases) on the skin of the male external genital system. Also, 80% of skin tumors were located (8 out of 10 cases) on the skin of the external genital system in male donkeys. It could be concluded that the skin of the male external genital system was the main predilection site for occurrence of skin tumors in the domestic equids. Overall, it seems conventional surgery is a high-rate successful practical technique in treatment of skin tumors in the domestic equids.

## Conflict of Interest

The authors declare there is no conflict of interest.

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