Some epidemiological studies on toe tumor in the Arabian Camel (*Camelus dromedarius)*

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Abstract

Toe tumor is a relatively common, aggressive and locally invasive in camels. The study was planned to investigate some aspects of toe tumor epidemiology. A total of 150 cases of toe tumor in Arabian camel has been reported to Al-Tiba Veterinary Hospital during the period of 2012-2014. Outpatient cases from different camel breeds (Hazmi, Local, Omani and Sudani). Were diagnosed after planing work-up for clinical and pathological investigations. A total of 37493 camles (6249 camel herds) were examined for the presence of toe tumor lesions. The overall prevalence rate of toe tumor in the present study was 0.4%. The prevalence of tumors in the Sudani, Local, Omani and Hazmi breed was 1.87%, 0.51%, 0.34% and 0.3%, respectively. Three different types of toe tumors squamous cell carcinoma (SCC), fibroma and spiny keratoderma were recorded in the present study. SCC showed a higher percentage of toe tumor (76.0 %), followed by Fibroma (21.33 %) and spiny keratoderma (2.67 %). The percentage of SCC was (15.79%, 29.82%, 45.61% and 8.78%) in Hazmi, Local, Omani and Sudani, respectively. Also, 15.62%, 29.82%, 45.61 and 6.25% of Fibroma were diagnosed in Hazmi, Local, Omani and Sudani, respectively, while Sping keratoderma was found only inLocal (75.00%) and Sudani breed (25.00%). The prevalence rate of toe tumor in female and male camels was 0.42% and 0.27%, respectively. The incidence of toe tumor was 101 (67.33%) in forelimb and 49 (32.67%) in the hind limb. The percentage of tumors in the right and left limbs was 88 (58.67%) and 60 (40.00%), respectively, while only 2 (1.33%) of the tumors were found in both limbs at the same time. The incidence of different types of tumors in relation to the position of the toes was (96.67%) in medial and (3.33%) in lateral, respectively. The percentage of toe tumors in left limb was 40.0% and in right limb was 58.67%.

The prevalence rate of different types of tumor, according to the age of camel involved was 34 (0.23%), 43 (0.38%), 40 (0.53%) and 33 (0.88%) in the age group 6-9, 10-11, 12-13 and 14-25 years, respectively. The tumors are particularly deleterious in that they can interfere with the normal physiological function of the musculoskeletal system that is essential for life.

Keywords: Arabian camel, toe tumor, incidence/prevalence, squamous cell carcinoma

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Introduction

Camels play an important socioeconomic role within the pastoral and agricultural system in the dry and semi-dry zones of Asia and Africa. The survival of millions of human beings is dependent on the camel in such areas for meat, milk and hair production and still an important mean of draught and transportation for large sectors of pastoral societies (El-Sawalhy *et al*., 1996). Camel is a large, strong desert animal, well adapted anatomically as well as physiologically to harsh climatic conditions of the desert. Nevertheless, it suffers from many various diseases that cause substantial economic losses in terms of decrease in working capacity, growth and productivity. The camel's foot resembles a tire filled with fat instead of air (Blight *et al*., 1976). It is well designed to accommodate with the loose sandy soils of the desert (Wilson, 1984). The foot pad of camels consisted of several layers including: the sole (cornified pad), common coverings, digital cushions and yellow bed (Hifney et al., 1988). The soft tissues of the camel's foot are subjected to several affections (Zabady, 1999) as traumatic pododermatitis (Ibrahim, 1976), neoplasms (El-Seddawy, 1978; Tageldin and Omar, 1986) , heel ulcer and separation of the cornified digital pad (Moustafa, 1979), sore feet, abscess, sole ulcer and elephant foot (Ramadan *et al*., 1986), burns (Gahlot *et al*., 1988), septic diffuse pododermatitis (Soliman *et al*., 1988), gangrene (Soliman *et al*., 1993), calcinosis circumscripta, edema of the foot, exuberant granulation and herniation of digital cushions (Singh and Gahlot, 1997), idiopathic skin lesion (Schwartz and Dioli, 1998), and grain founder (Sharma and Sharma, 2006).

The tumors are an abnormal growth of tissues without any control and serving no useful function. It may be soft or hard, swollen and vascularized. A camel is a unique animal, which has the capability to survive in the extreme conditions of heat and cold, but even then not left for the development of tumors. The tumors are found on the skin and various visceral organs of camel are mostly benign type. Occurrences of malignant tumours are very limited (Sivakumar and Shrish, 2010). Although camelid neoplasia has been rarely reported in the literature, it is presumed that camelids are susceptible to all tumor types that affect domestic ungulates (Fowler, 2003). Renal cell carcinoma (Vitovec, 1982), bronchoalveolar adenocarcinoma (Gameel *et al*., 1998), squamous cell carcinomas (Ramadan & EL-Hassan, 1989; Tageldin & Omar, 1986), Salivary fibro-adenocarcinoma (Ramadan *et al*., 2001), multicentric t-cell lymphoma (Simmons *et al*., 2005), Vertebral osteoma (Carbonell *et al*., 2006), mammary and pulmonary carcinoma (Bryant *et al*., 2007), Rhabdomyosarcoma (Zakia *et al*., 2007), basal cell carcinoma (Al-Hizab *et al*., 2007), seminoma with cholangiocarcinoma (Birincioglu *et al*., 2008), peripheral primitive neuroectodermal tumor (Weiss and Walz, 2009), Multicentric Schwannoma (Khodakaram-Tafti and Khordadmehr, 2009) and recently cutaneous papillomatosis (Barakat et al., 2013; Barker *et al*., 1993; Hussain *et al*., 2012) have been reported in the dromedary camel. Fahd and Yasmin, (2013), classified and described some external tumors of single-humped camels as well as their diagnosis after surgical excision and to determine the link between occurrence of tumors and breed, sex, age,

coat color, and tumor location. Tumors were seen in three local breeds: Maghateer, Majaheem, and Sofr. Four different types of tumors were diagnosed in camels, namely, squamous cell carcinoma (SCC), fibroma, lipoma and fibromyxosarcoma. The most common type of tumor in a white colored coat Maghateer breed was SCC (69.2%), while in dark brown to black coat Majaheem breed was fibroma (66.7%). Singh & Gahlot (1997) recorded the incidence of foot disorders to be more in males in animals between five and ten years of age, groups with more involvement of fore feet than hind feet. The acquired foot affections were classified according to the part of foot affected viz. affection of skin, sole, nails and musculoskeletal system. Abscess, wounds and dermatitis were the common foot affections, but punctured sole was the commonest. Less commonly seen was exuberant granulation, idiopathic skin lesions, hernia of the digital cushion. The diagnosis of hernia of digital cushion was done by exploratory surgery, abscess by exploratory puncture and musculoskeletal disorders by clinical and radiographic examination and squamous cell carcinoma of volar and interdigital space histopathologically (Marie *et al*., 2012). Growths may be seen at the pad junction and on the pad itself. As they grow, they often become nodulated and ulcerated, and may be subjected to frequent trauma. Such growths have been identified as fibromas and squamous cell carcinomas. The latter are usually more aggressive than the former. An incidence of squamous cell carcinoma is 2.88% in the camels and appears as an exuberant granulation about five centimeters in diameter and is spongy, fragile and has a tendency to bleed; on the fore or hind foot on the surface of the sole (Gahlo, 2000c). It has been reported in camels on the sole (Gahlot *et al*., 1995) and at the inter-digital space (Tageldin and Omar, 1986). It has been reported by several researchers that toe tumor is the most common tumor in camel in UAE (Al-Juboori, 2011; Siddiqui *et al.*, 2013). The higher incidence has been recorded of the medial toes of the fore limbs(Siddiqui *et al*., 2013; Siddiqui and Tellfah, 2010). Constant irritation that results in ulceration wound of sole and overgrown of toe nails are considered as possible causes (Abdulwahhab, 2008). Cancer epidemiology is an important field of cancer research and is a growing field in veterinary medicine and has been important to determine the statistical data of the disease by allowing the survey of the incidence cases, tracing of breeds predispose to certain types of cancer, the study of the age group most affected and the relationship of epidemiological data about the quality of animals life in each study region. There is a great paucity of information on the epidemiology of toe tumor in camels. Accordingly, the present study was taken up with a view to determine the different aspects of toe tumor epidemiology in camels. It may be mentioned that, prior to this no detailed studies had been made on the toe tumor in camels in UAE.

Materials and methods

Animals

The present study was carried out on 150 clinical cases of camels (12 male and 138 female) with toe tumor that were presented to Al-Tibaa Veterinary, Animal Wealth Sector, ADFCA, Abu Dhabi from 2012-2014. The farm size ranged between five and 20 camels. Four breeds of camel (Hazmi, Oman, Sudan and Local) from different age group (6-9, 10-11, 12-13 and 14-25 years) and sexes were included in this

study. Additional data concerning the identity of the camel, housing and management, sex, season, concurrent disease, body weight, age, duration of lesions, feed intake and medication of the camel were collected. In order to determine the incidence/prevalence of toe tumor in camels, a total of 37493 camles (6249 camel herds) was examined for the presence of toe tumor lesions. Outpatient cases of toe tumor were diagnosed after planning work up for clinical and pathological investigations. Diseased camels were suffering from varying degrees of tumors, loss of appetite and weight with the presence of abnormal growth in the toe. Sick animals were carefully examined for clinical signs, type, size, location and position of tumor on the right and left limbs, severity and location of tumors and also for the general body condition. Camels were stalled freely and fed on 4kg of concentrate /head daily, green fodder, fresh water and common salts were provided ad lib.

All procedures involving the collection of samples and handling of animal were approved by the Animal Ethic Committee of the Faculty of veterinary Medicine,University Malaysia Kelantan, Karung Berkunci 36, Pengkalan Chepa,16100, Koto Bharu, Kelantan, Malaysia (8-10-2012, Issue No. 02).

Statistical analysis

Least-square analysis of variance was used to study the effect of infection status, age, class, breed, sex, season, and year, using the GLM of SAS, (2004). Prevalence and incidence among different classes were tested using Freq of SAS (2004).

Results

During the period of 2012-2014, 150 outpatient cases of toe tumor in camels were diagnosed. The cases were diagnosed after clinical and pathological examinations. In order to determine the incidence of toe tumor in camels, a total of 37493 camles (6249 camel herds) was examined for the presence of toe tumor lesions. These were Hazmi (7783), Local (8979), Omani (20037) and Sudani (694) breed. The results are presented in Table 1. The overall prevalence rate of toe tumor in the present study was 0.4%. The prevalence of Sudani, Local, Omani and Hazmi breed was 1.87%, 0.51%, 0.34 and 0.3%, respectively. The results are presented in Table 1. Three different types of toe tumors (Squamous cell carcinoma, fibroma and spiny keratoderma) were recorded in the present study (Table 1.). Squamous cell carcinoma (SCC) was the most prevalent type of toe tumor (n=114) (76.0 %), followed by Fibroma 32 (21.33 %) and spiny keratoderma 4 (2.67 %). The percentage of SCC was (15.79%, 29.82%, 2 45.61% and 8.78%) in Hazmi, Local, Omani and Sudani, respectively. 15.62%, 29.82%, 45.61 and 6.25% of Fibroma (n=32) (21.33 %) and spiny keratoderma (4) (2.67 %). The percentage of SCC was 15.79%, 29.82%, 45.61% and 8.78% in Hazmi, Local, Omani and Sudani, respectively. 15.62%, 28.13%, 50% and 6.25% of fibroma was diagnosed in Hazmi, Local, Omani and Sudani, respectively. While Sping keratoderma was found only in local (75.00%) and Sudani breed (25.00%). The prevalence rate of toe tumor in female and male was 138 (0.42%) and 12 (0.27%), respectively (Table 1).

The data available on the relative frequency of different types of tumors in relation to type, location and position of the right and left limbs are presented in Table 2. The

incidence of toe tumor was 67.33% (n=101) in forelimb and 32.67% (n=49) in the hind limb. The percentage of tumors in right and left limbs was 58.67% (n=88) and 40.00% (n=60), respectively. While only 2 cases of the tumors was found on both limbs at the same time (1.33%). The incidence of different types of tumors in relation to the position of the limbs was 96.67% on medial and 3.33% on lateral position, respectively. The percentage of toe tumors in the left limb was 40.0% and in the right limb was 58.67%. It was further observed that the prevalence rate of different types of tumor, according to the age of camel involved, was 0.23% (n=34), 0.38% (n=43), 0.53% (n=40) and 0.88% (n=33) in the age group 6-9, 10-11, 12-13 and 14-25 years, respectively. The tumor sizes in relation to the camel's breed was presented in Table. 4. The incidence rate of large weight, size was 17.39% (n=4), 39.13% (n=18), 23.53% (n=16) and 15.38% (n=2) in Hazmi, Local, Omani and Sudani breed, respectively. While 26.09% (n=6%), 10.87% (n=5), 19.12% (n=13) and 53.85% (n=7) in Hazmi, Local, Omani and Sudani breed, respectively was medium size. The percentage of small size was 56.52% (n=13), 23 50.0% (n=23), 57.35% (n=39) and 30.77% (n=4) in Hazmi, Local, Omani and Sudani breed, respectively. Taking into consideration all the camels examined during this study, the percentage on tumor weight basis was 52.67% (n=79), 26.67% (n=40) and 20.67% (n=31) in large, medium and small sizes, respectively.

Table 1. Incidence and sex distribution of toe tumor in different camel breeds.

Characteristic	**Camel's breed with number examined (%)**								**Total** 37493
	Hazmi 7783		**Local** 8979		**Omani** 20037		**Sudani** 694		
	Male	**Female**	**Male**	**Female**	**Male**	**Female**	**Male**	**Female**	**Incid. (%)**
Sex P value for χ^2									< 0.001
Squamous cell carcinoma	3 (2.6%)	15 (13.2%)	2 (1.8%)	32 (28.1%)	3 (2.6%)	49 (43.0%)	1 (0.9%)	9 (7.9%)	114 (76.0%)
Total	18 (15.8%)		34 (29.8%)		52 (45.6%)		10 (8.8%)		(100)
Fibroma	0 (0.0%)	5 (15.6%)	1 (3.1%)	8 (25.0%)	2 (6.3%)	14 (43.8%)	0 (0.00)	2 (6.3%)	32 (21.3%)
Total	5 (15.62%)		9 (28.13%)		16 (50.00%)		2 (6.25%)		(100)
Sping keratoderma	0 (0.00)	0 (0.00)	0 (0.00)	3 (75.0%)	0 (0.00)	0 (0.00)	0 (0.00)	1 (25.0%)	4 (2.67%)
Total	0 (0.0)		3 (75.0%)		0 (0.0)		1 (25.0%)		(100)
Total	3 (2.0%)	20 (13.3%)	3 (2.0%)	43 (28.7%)	5 (3.3%)	63 (42.0%)	1 (0.7%)	12 (8.0%)	150 (100%)
Total Incidence rate (n with %)	23 (0.3%)		46 (0.5%)		68 (0.3%)		13 (1.9%)		150 (0.4%)

Values significantly different (P < 0.0001) between male and female in different breeds.

Table 2. Distribution of toe tumors in camels in relation to the type, location and position of limbs involved

Characteristic	No. of camels showed toe tumor	Incidence %
Location		
Both	2	1.33 %
Left	60	40.00 %
Right	88	58.67 %
P value for χ^2		**< 0.0001**
Position		
Lateral side	5	3.33 %
Medial side	145	96.67 %
P value for χ^2		**< 0.0001**
Type		
Fore limb	101	67.33 %
Hind limb	49	32.67 %
P value for χ^2		**< 0.0001**

Values significantly different (P < 0.0001) between the type, location and position of limbs.

Table 3. Prevalence of toe tumor in in relation to the age of camels.

Characteristic	No. of camels examined	No. of camels showed toe tumor (Prevalence rate %)
Camel breed		
Hazmi	7783	23 (0.3 %)
Local	8979	46 (0.51 %)
Omani	20037	68 (0.34 %)
Sudan	694	13 (1.87 %)
Total	37493	150 (0.40 %)
P value for χ^2		**< 0.0001**
Age (year)		
6-9	14997	34 (0.23 %)
10-11	11248	43 (0.38 %)
12-13	7499	40 (0.53 %)
14-25	3749	33 (0.88 %)
Total	37493	150 (0.4 %)
P value for χ^2		**< 0.0001**
Sex		
Female	32994	138 (0.42 %)
Male	4499	12 (0.27 %)
Total	37493	150 (0.4 %)
P value for χ^2		**< 0.1309**

Values significantly different (P < 0.0001) between camel age and breeds.

Table 4. The incidence of weight of the different types of tumor in relation to camel's breed involved

Characteristic	Hazmi	Local	Omani	Sudani	Total
Tumor size P value of χ^2					**< 0.0177**
Large (> 5 cm)	4 (17.39)	18 (39.13)	16 (23.53)	2 (15.38)	40 (26.67)
Medium (2-4cm)	6 (26.09)	5 (10.87)	13 (19.12)	7 (53.85)	31 (20.67)
Small (1-2 cm)	13 (56.52)	23 (50)	39 (57.35)	4 (30.77)	79 (52.67)
Total	23 (15.33)	46 (30.67)	68 (45.33)	13 (8.67)	150 (100)
Legs P value for χ^2					**< 0.6182**
Both	0 (0)	0 (0)	2 (2.94)	0 (0)	2
Left	11 (47.83)	18 (39.13)	24 (35.29)	7 (53.85)	60
Right	12 (52.17)	28 (60.87)	42 (61.76)	6 (46.15)	88
Total	23 (15.33)	46 (30.67)	68 (45.33)	13 (8.67)	150(100)
Side P value for χ^2					**< 0.436**
Lateral side	2 (8.7)	1 (2.17)	2 (2.94)	0 (0)	5
Medial side	21 (91.3)	45 (97.83)	66 (97.06)	13 (100)	145
Total	23 (15.33)	46 (30.67)	68 (45.33)	13 (8.67)	150 (100)
Fore Hind P value for χ^2					**< 0.6378**
Fore	18 (78.26)	29 (63.04)	45 (66.18)	9 (69.23)	101
Hind	5 (21.74)	17 (36.96)	23 (33.82)	4 (30.77)	49
Total	23 (15.33)	46 (30.67)	68 (45.33)	13 (8.67)	150 (100)

Values significantly different ($P < 0.1$), * ($P < 0.05$), ** ($P < 0.01$), *** ($P < 0.001$) between different breeds.

Discussion

A number of benign and malignant tumors have been previously reported in the skin and subcutaneous tissues of one-humped camels (Abdulwahhab, 2003; AlSobayil *et al*., 2013). In the literature there is little information on toe tumor of camels worldwide (Al-Juboori (2011). Siddiqui and Tellfah (2010) and Al-Juboori (2011) in UAE have reported that toe tumor is the most common tumor in camels. The overall prevalence rate of toe tumor in the present study was 0.4%. Sudani camel breed was highly susceptible to toe tumor as compared to other breeds in the present study. The prevalence rate of toe tumor in Sudani breed was higher as compared with the other camel breeds involved in the study. This, probably, can be attributed to the fact that Sudani breed is considered high breed racing camel that characterized by by long limbs and wide chest. Such characterizations may exposes this breed to more limbs trauma and injuries. Also, Sudani camel breed usually has slight white coat as compared to other camel breeds. This characteristic may probably increased the sensitivity to ultraviolate radiation by the sunlight. AlSobayil *et al*. (2013) found cutaneous SCCs were seen in an increased frequency in camels especially on the Maghateer breed of the white colored coat (n = 9, 69.2%). Hargis *et al*. (1977), Ladds and Daniels

(1982), Valentine (2004), Lyon (2007), Scott (2007) and Barbosa *et al*. (2009) had reported that the white or gray coat exposure to sunlight or exposure to photosensitizing plants and non-pigmented glabrous skin appear to be predisposing factors to tumors. The overall prevalence rate of toe tumor in the present study was low as compared with Siddiqui *et al*. (2013) who reported incidence rate of toe tumor to be 29.09%. However, Al-Juboori (2013) recorded the incidence of foot tumor that caused lameness in racing camels in the United Arab Emirates to be 0.47%. In Saudi Arabia, AlSobayil *et al*. (2013) found higher incidence of foot tumors (34.6%). AlSobayil *et al*. (2013) reported that Maghateer breed was more susceptable to skin tumors as compared to Majaheem and Sofr breed. It was further observed that a higher percentage of toe tumor 76.0 % (n=114) had squamous cell carcinoma (SCC) followed by fibroma 21.33 % (n=32) and keratoderma (2.67 %) (n=4). Siddiqui *et al*. (2013) found (out of 50 tumor-like growths in the toe nail of Arabian camels) three types of tumors were encountered; namely SCC (70%), spiny keratoderma (22%) and fibroma (8%). Squamous cell carcinoma is a relatively common, locally invasive, and occasionally metastatic neoplasm of most domestic species (Ali *et al*., 2010). A retrospective study on the incidence of bovine external neoplasms in southwestern Iran by Kohli *et al*. (2007) showed that squamous cell carcinomas were the most common tumor (62%) followed by papillomas (26%). Christina (2014) identified seven cases of neoplasia in an alpaca (4 cases of malignant lymphoma in alpacas, one case of cholangiocarcinoma in an alpaca, one case of disseminated sarcoma in a camel and one case of myeloid leukemia/preleukemia). The prevalence of toe tumor was higher in females (0.42 %) (n=138) than in males (0.27 %) (n=12). These findings were in accordance with the observations of Siddiqui *et al*. (2013). AlSobayil *et al*. (2013) found the incidence of neoplasia was significantly higher in females than males. The higher incidence of toe tumor in this study has been recorded in the medial toes of the fore limbs. These observations, in general, agree with findings of Siddiqui *et al*. (2013) who noticed that the medial toenails of the fore limbs are most commonly affected with tumors. Continuous irritation resulted in ulcerative type of wound at sole and overgrowth of toe nails are considered a possible cause. These findings, in general, agree with the observations of (Al-Juboori, 2011; Al-Juboori and Baker, 2012b; Siddiqui *et al*., 2013; Siddiqui and Tellfah, 2010). Prolonged and continuous exposure to sunlight is the best known etiologic factor, and a sunlight-induced skin cancer relationship has been established in several domestic species (Valentine, 2006). Generally, ultraviolet radiation (UV) is the major etiologic agent in skin cancer development (Ladds and Daniels, 1982; Scott, 2007; Tageldin an Omar, 1986; Valentine, 2004); especially squamous cell carcinoma in cows, goats, sheep, cats and dogs Hargis *et al*. (1977), Nikula *et al*. (1992) and Barbosa *et al*. (2009). Amonge a total of 150 toe tumor cases in the present study, the high prevalence rate was reported in the camel age group 14-25 year 0.88%. In alpacas, Christina (2014) reported the age span of affected alpacas to be wide, ranging from 18 months to 14 years with an average age of 5.5 years. However, the majority (3.5) were young adults under the age of three years. The age of the camel with disseminated sarcoma was not specified but

in the files she referred to it as an adult (Christina, 2014).

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