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A clinical and histopathological study of ocular neoplasms in dairy cattle

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ABSTRACT

The aim of this study was to show the natural occurrence of ocular neoplasms in dairy cattle kept in 8 dairy farms around Tehran consisting of approximately 5000 dairy cows, over a period of two years. Animal characteristics, type of husbandry and climatic conditions were recorded. Tumours were removed surgically and examined grossly and microscopically. In the present study 32 cases of ocular neoplasms were diagnosed. The affected animals were female (100%), adult and more than 50% of them aged more than five years. In most of the cases (70%) the lesion were located in the nictitating membrane and palpebral conjunctiva. Intraocular invasion was noted in 7 cases (21.87%). Microscopically, in 12 cases out of 32 (37.5%) the tumours were noninvasive squamous cell carcinoma or carcinoma in situ; 18 cases (56.25%) were invasive squamous cell carcinoma; a single case (3.12%) was lymphosarcoma while a further single case (3.12%) was malignant hemangioendothelioma. The grade of malignancy was assessed for each case of neoplasms based on descriptions appearing in the literature. Most of the ocular neoplasms diagnosed were squamous cell carcinoma, mostly located in the nictitating membrane and palpebral conjunctiva.

Key words: squamous cell carcinoma, cattle, pathology

Introduction

Ocular squamous cell carcinoma is the most common neoplasm of the eye in cattle. Bovine ocular squamous cell carcinoma (OSCC), also called “Cancer eye”, represents the

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most economically important neoplasm in large animals. The economic impact includes carcass condemnations, production losses, treatment expenditure and management costs. It is the most common tumour affecting cattle in North America (BASTIANELLO, 1982; HAMIR and PARRY, 1980; HEENEY and VALLI, 1985; CORDY, 2002; ROBERTS, 1996).

The tumour in all species develops through a series of premalignant stages, called epidermal plaques and papillomas, before proceeding over months or years to carcinoma in situ and to invasive carcinoma (WILCOCK, 1993).

RUSSELL et al. (1956) and MONLUX et al. (1957) reported the sites of a combined total of more than 1000 ocular carcinomas and benign precursor lesions. Approximately 75% were on the bulbar conjunctiva and cornea (90% at the limbus and 10% on the cornea) and the remaining 25% were found in the conjunctiva of the eyelids, membrana nictitans and the skin of the eyelids. Lymphosarcoma and hemangioendothelioma of the eye have been also reported in cattle. However, the occurrence of these eye tumours is uncommon to rare (WILCOCK, 1993).

The aim of the present study was to determine the type and pathological characteristics of neoplastic growths of the ocular surface of dairy cattle in dairy farms in Tehran province.

Materials and methods

Over a 2-year-study period, a total of 5000 cattle, adult Holstein-Friesian dairy cows, from 8 dairy farms located around Tehran were studied.

Clinical signs and symptoms, nutritional status and type of husbandry, climatic conditions, age, sex and breeds of animals, as well as the size, location, shape, colour and any changes related to the tumours were recorded. Using standard procedures the tumours were excised surgically under sedation and local anaesthesia.

The tumours were cut into pieces and fixed in 10% neutral formaldehyde solution. The formaldehyde-fixed tissue specimens were processed in a tissue processor (Autotechnicon Co., U.S.A.); paraffin blocks were made; 5-6 μm thick sections were cut with a microtome (Jung Co., Germany) and stained with Harris haematoxylin and eosin and Ayoub- Shekhlar method for demonstration of keratin in tissue sections (LUNA, 1968).

Microscopically, degree of differentiation, type of growth pattern of neoplastic cells, cellular characteristics of parenchyma, mitotic index, necrosis and haemorrhages, invasion to stroma, vessels and lymphatics and host inflammatory responses, degree of the malignancy and anaplasia were recorded.

All tumours were histologically classified with regard to microscopic features, especially according to the degree of differentiation, into five categories: carcinoma in situ (G_0), well differentiated (G_1), moderately differentiated (G_2), poorly differentiated

(G_3) and anaplastic (G_4) carcinoma (GOLDSCHMIDT et al., 1998; CARVALHO, 2005). Differentiation was evaluated according to the presence and intensity of keratinization, squamous differentiation and island formation of neoplastic cells and invasiveness. The G_0 reflected noninvasive carcinoma with malignant transformation of the epithelial cells in the basilar layer and stratum spinosum. This form of neoplasm was noninvasive and confined by a basement membrane. The G_1 reflected well-differentiated neoplasms containing numerous large keratin pearls and formation of large islands with obvious squamous differentiation and minimal signs of invasion of the surrounding tissues. The G_2 was attributed to moderately differentiated neoplasms with a moderate degree of keratinization and differentiation with an increased number of poorly differentiated cells, exhibiting small- to medium-sized keratin pearls and islands, and the small islands of invasive or noninvasive neoplastic cells surrounding the main tumour. G_3 was referred to neoplasms consisting of individual cell keratinization, a few small-sized tumour islands, poor cellular differentiation and deep invasion far from the main tumour. G_4 was attributed to neoplastic tumours consisting of small hyperchromatic or spindle cells with little evidence of squamous differentiation or keratinization.

Results

Clinical findings. All animals under investigation were female, black and white Holstein-Friesian dairy cows, kept in dairy farms located around Tehran. Environmental conditions in the areas where the dairy farms are located are warm and dry in summer and autumn and relatively cold in winter. Fluctuation of temperature of this area is in the range of 0-40 degree Centigrade. Mean daily sunlight period over the year is 8 to 10 hours.

In this study, on the basis of history, the age of patients was recorded in 26 cases out of 32 (81.25%). Patient age ranges included 0-23 months (no cases were observed); 24-47 months (6 cases); 48-71 months (12 cases); 72-95 months (5 cases) and 96-120 months (3 cases). The average age of cattle was approximately 61.5 months with an age range of 30-108 months (2.5-9 years). Approximately 2 out of 32 (6.25%) of the tumours were located at the limbus and cornea, and 23 cases out of 32 (71.88%) of the lesions were found in the conjunctiva of the eyelids and nictitating membrane and the skin of the eyelids, and in 7 cases out of 32 (21.875%) the neoplasms replaced the entire eyeball and in 2 (6.25%) of these cases the tumour deeply invaded skull tissues. Lesions were present on the right eye in 13 cases (40.6%), on the left eye in 12 cases (37.5%), while in 7 cases (21.9%) both eyes were affected.

Table 1. Clinical characteristics and types of ocular neoplasms, diagnosed in 32 cases of bovine with eye tumours

Case N°	Age (year)	Tumour location	Affected eyes		Size (cm)	Surface appearance	Tumour diagnosis and grade
			right eye	left eye			
1	5.5	third eyelid (nictitating membrane)	+	-	1.5×2.5	nodular and hyperemic	SCC (G_2)
2	5.5	third eyelid and the conjunctiva of the upper eyelid (upper palpebral conjunctiva)	+	-	1.25×3.3	nodular	noninvasive carcinoma (SCC in situ) (G0) (with microinvasion of neoplastic cells to the stroma)
3	7	third eyelid and the conjunctiva of the eyelids (palpebral conjunctiva)	-	+	2.5×2.75	nodular and hemorrhagic (with purulent discharge)	noninvasive carcinoma (SCC in situ) (G0)
4	8	third eyelid	+	-	0.5×0.5	nodular	SCC (G_3)
5	4.5	third eyelid and upper eyelid and peripheral tissues of eye bulbar	-	+	2.5×1.75	nodular and hemorrhagic (with purulent discharge)	SCC (G_3)
6	5	third eyelid	+	-	0.75×1.75	nodular	SCC (G_1)
7	4	limbus and cornea	-	+	2.2×3	Cauliflower-like with haemorrhages and purulent discharge	SCC (G_4)
8	6	limbus and cornea	+	-	2.5×1	Cauliflower-like and congested	malignan themangio-endothelioma

Table 1. Clinical characteristics and types of ocular neoplasms, diagnosed in 32 cases of bovine with eye tumours (continued)

Case N°	Age (year)	Tumour location	Affected eyes		Size (cm)	Surface appearance	Tumour diagnosis and grade
			right eye	left eye			
9	6	nictitating membrane and palpebral conjunctiva	+	-	4×1.75	Nodular	SCC (G_2)
10	7	the conjunctiva of the lower eyelid (lower palpebral and tarsal conjunctiva)	+	-	6.75×1.5	Nodular	SCC (G_2)
11	NA	nictitating membrane	-	+	1.8×1.2	Nodular	SCC (G_1)
12	9	nictitating membrane and lower palpebral conjunctiva	-	+	2×1.2	Nodular	SCC (G_2)
13	2.5	nictitating membrane and palpebral conjunctiva	+	+	2×3.5	Cauliflower-like appearance with keratitis	SCC (G_1)
14	2.5	third eyelid	+	-	1×1.5	Cauliflower-like appearance with keratitis	noninvasive carcinoma (G_0) with chronic inflammation and massive infiltration of lymphocytes
15	3	nictitating membrane	+	+	left eye: 0.5×0.75 right eye: 0.32×0.75	Nodular	noninvasive carcinoma (SCC in situ) (G0)
16	3	nictitating membrane	-	+	(2 nodules) 1: 0.1×0.1 2:0.2×0.2	nodular	noninvasive carcinoma (SCC in situ) (G0)

Table 1. Clinical characteristics and types of ocular neoplasms, diagnosed in 32 cases of bovine with eye tumours (continued)

Case N°	Age (year)	Tumour location	Affected eyes		Size (cm)	Surface appearance	Tumour diagnosis and grade
			right eye	left eye			
17	5	nictitating membrane	+	+	left eye: 0.3×0.3 right eye: 0.2×0.2	nodular	noninvasive carcinoma (SCC in situ) (G0)
18	3	nictitating membrane	+	-	0.8×0.5	Nodular	noninvasive carcinoma (SCC in situ) (G0)
19	3	nictitating membrane(the tumour replaced the entire eye)	-	+	the entire eye was destroyed	Nodular	SCC (G_2)
20	5	the base of third eyelid and lower palpebral conjunctiva	+	-	2×2.5	Nodular	SCC (G_2)
21	7	the tumour replaced the entire eye but the eyelids were intact	-	+	the eyeball was destroyed by the tumour	nodular	SCC (G_1)
22	NA	nictitating membrane	-	+	0.25×0.5	nodular	noninvasive carcinoma (SCC in situ) (G0)
23	5	nictitating membrane	+	+	numerous nodules with 0.1-0.2 cm in diameter	nodular	noninvasive carcinoma (SCC in situ) (G0)
24	NA	nictitating membrane	+	+	numerous nodules with 0.1-0.2 cm in diameter	nodular with keratitis	dysplasia and noninvasive carcinoma (G0)
25	NA	nictitating membrane	+	+	numerous plaques with 0.1-0.3 cm in diameter	plaque with rough surface	SCC (ND)

Table 1. Clinical characteristics and types of ocular neoplasms, diagnosed in 32 cases of bovine with eye tumours (continued)

Case N°	Age (year)	Tumour location	Affected eyes		Size (cm)	Surface appearance	Tumour diagnosis and grade
			right eye	left eye			
26	NA	nictitating membrane	-	+	0.1×0.2	nodular	noninvasive carcinoma (SCC in situ)
27	NA	nictitating membrane	+	+	0.2×0.2	nodular	noninvasive carcinoma (SCC in situ) (G0)
28	4	the tumour replaced the entire eyeball	+	-	the eyeball was replaced by the tumour	nodular with purulent discharge accompanied by foul odour	SCC (G_3)
29	9	nictitating membrane and palpebral conjunctiva	+	-	ND	nodular with keratitis and ulceration of cornea	SCC (ND)
30	4	palpebral conjunctiva	-	+	the tumour relatively replaced the entire eye	nodular	SCC (G_2)
31	5	nictitating membrane and palpebral conjunctiva	-	+	The tumour replaced the entire eye. Before the right bulbus was extirpated due to BOSCC	nodular	SCC (G_2)
32	5	nictitating membrane and muscles of eyeball (periorbital tissues)	-	+	left eye, heart, abomasums and lymph nodes were involved	diffuse with exophthalmia	Lymphosarcoma

G - grade; NA - not available; ND - not defined

Gross pathology. Macroscopically, the lesions were papillomatous growths of varying size with fleshy, sometimes crumbly masses that attached to the lid or the orbit on a wide base. These were often even when the eyelids were closed and caused increased lacrimation and sometimes discharge of pus. The lesions varied in size from a few millimetres to several centimetres (Table 1), many of which had a nodular or cauliflower-like appearance. Size of the lesions was recorded in 25 cases out of 32 (78.12%) of the animals with 11 cases ≤1 cm and 14 cases >1 cm. The surfaces tended to be ulcerated and bled easily.

Histopathology. Microscopically, in 12 cases out of 32 (33.3%) the tumours were squamous cell carcinoma in situ (noninvasive carcinoma) (G_0). This form of the neoplasm showed malignant transformation of the epithelial cells in the basilar layer or, less commonly, in the stratum spinosum (Fig. 1). The neoplastic cells displayed hyperchromatic nuclei, numerous mitotic figures, pleomorphism and loss of polarity. The squamous cells were noninvasive and confined by a basement membrane (Fig. 1). At this stage, there was no invasion through the basement membrane by the dysplastic keratinocytes, but microinvasion of neoplastic cells to the stroma was observed in a single case (Case 2).

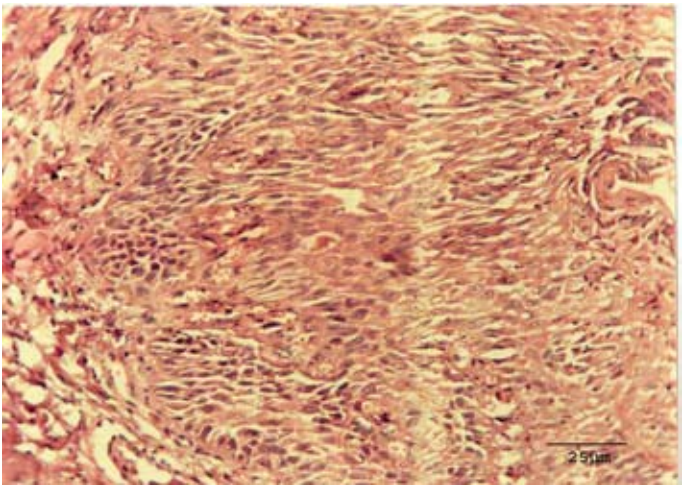

Fig.1. Microscopic view of carcinoma in situ (G_0) of third eyelid. The neoplastic cells are dysplastic and mostly have a spindle shape and are confined by a basement membrane. H&E; ×768.

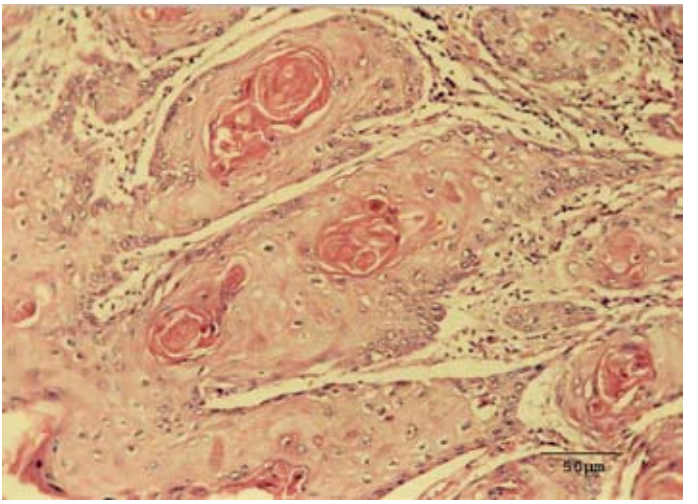

Fig. 2. Microscopic view of well-differentiated squamous cell carcinoma (G_1) of the eye. Many onion-like eosinophilic keratin pearls and large-sized tumour islands are evident. H&E; ×384.

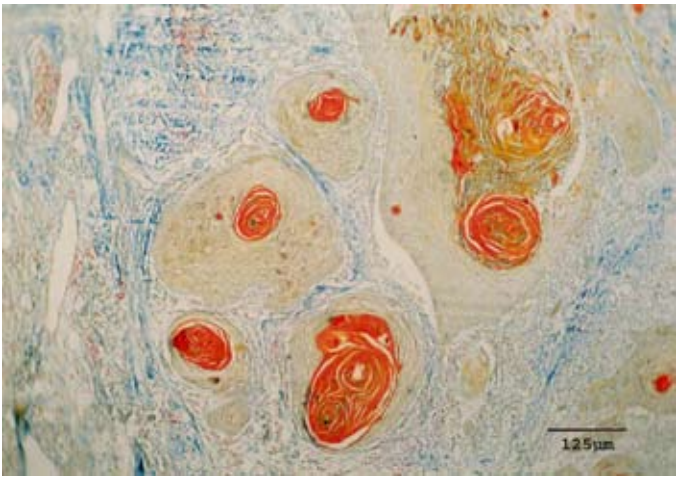

Fig. 3. Microscopic appearance of well-differentiated squamous cell carcinoma (G_1) stained with Ayobb-Shekhlar method. Large keratin pearls appears as red onion-like structures. ×160.

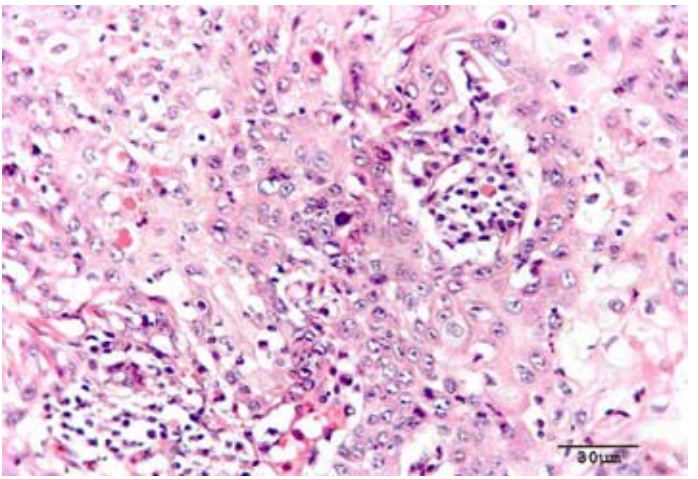

Fig. 4. Microscopic view of poorly differentiated squamous cell carcinoma (G_3) of the eye. Because of anaplastic characteristics of the neoplasm production of keratin material is low. H&E; ×640.

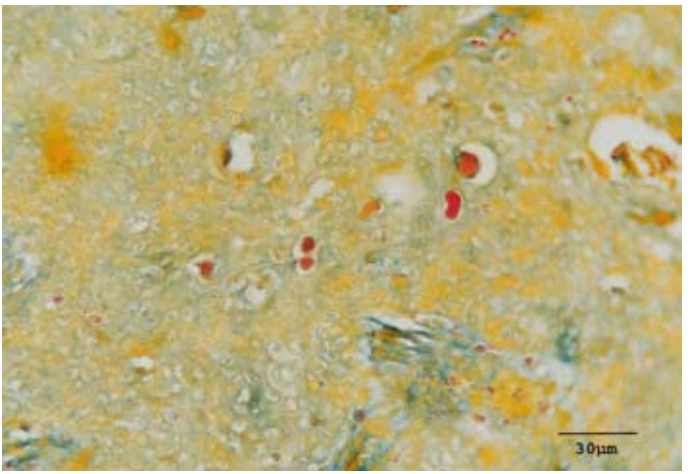

Fig. 5. Section of poorly differentiated squamous cell carcinoma (G_3) of the eye stained with Ayobb-Shekhlar method. Small areas of keratinization indicated low synthesis of keratin by tumour cells. ×640.

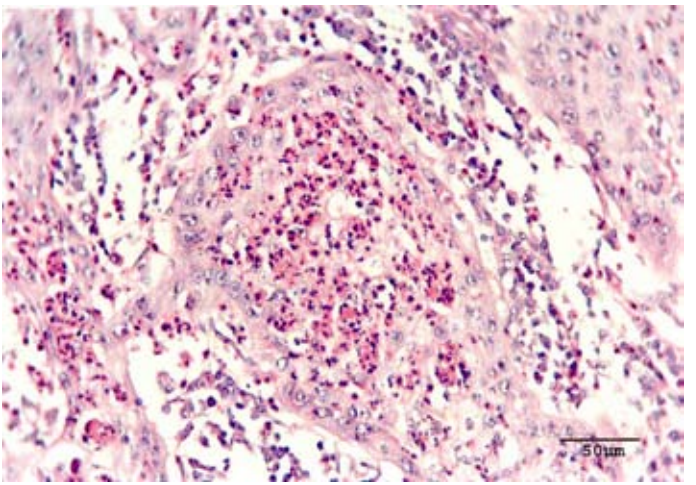

Fig. 6. A section of poorly differentiated squamous cell carcinoma (G_3) of the bovine eye infiltrated with a large numbers of eosinophils. These have numerous spherical eosinophilic granules that fill the cells. There are many lymphocytes also present in the stroma of the tumour. H&E; ×640.

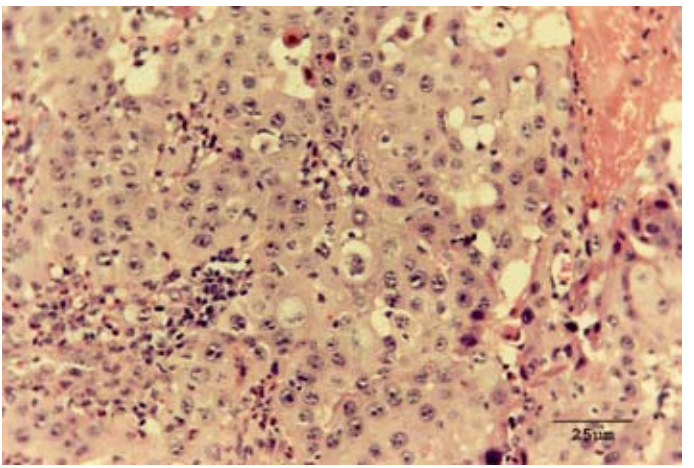

Fig. 7. Poorly differentiated squamous cell carcinoma (G_3) of the bovine eye. Pleomorphism, hyperchromatism of the neoplastic cells, poor spinous differentiation, and vaculation of neoplastic cells, large prominent nucleoli, mitotic figures and individually keratinized cells are evident. H&E; ×768.

Eighteen cases out of 32 (56.25%) of the tumours were invasive carcinoma, their distribution being as follows: G_1, 4 (12.5%); G_2, 8 (25%); G_3, 3 (9.375%); G_4, 1 (3.125%). Two (6.25%) cases were not graded. Histologically, G_1 to G_3 forms of the tumour exhibited keratin pearl formation (Figs. 2, 3), premature keratinization (Figs. 4, 5, 7), pleomorphism, nuclear hyperchromatism, variation in size of nuclei, karyomegaly, mononuclear tumour giant cells and multinucleated tumour giant cells (bizarre cells), enlarged and prominent nucleoli (Fig. 7), loss of polarity, vaculation of cytoplasm (Fig. 8), atypic mitotic figures and evidence of single cell necrosis and apoptosis of neoplastic cells. Nuclear to cytoplasmic ratio (N/C) was markedly increased from $^1/_6$ to $^1/_4$ in normal squamous cells to $^1/_1$ or $^2/_1$ in neoplastic cells (Figs. 7, 8).

Irregular masses and elongated cords of neoplastic cells extended haphazardly throughout the neoplasms. Infiltrating cords of large neoplastic cells had lost their cellular polarity, had disrupted basement membrane and invaded the tissues of the eye and surrounding adjacent tissues to varying degrees. Cross-sections of these cords appeared as islands of neoplastic epithelium surrounded by stroma. The tumour cells showed keratinization in fairly normal fashion. Basal cells were at the periphery of the invading columns and gradually differentiated into the keratinized cells presented in the centre of the columns. Mitotic figures were conspicuous in the neoplasms and many of them were atypical in appearance. Keratin pearls and intercellular bridges were readily found in all but the most anaplastic tumours.

In poorly differentiated carcinoma (G_3) individually keratinized cells were evident. The individual tumour cells undergoing keratinization were large and round and had an abundant glassy, deeply eosinophilic cytoplasm, distinct cell borders and pyknotic nucleus. In some of them, degeneration (acantholysis) in the centres of the invading columns gave the tumours a pseudoglandular appearance.

In anaplastic tumours (G_4), highly anaplastic cells were seen and consisted of small, hyperchromatic or spindle cells with little evidence of squamous differentiation or keratinization (Fig. 9).

Secondary changes, such as necrosis, ulceration, haemorrhage and inflammatory cells infiltration of tumour stroma appeared in most of the carcinomas. Tumour invasion was accompanied by an infiltration with a varying number of lymphocytes (small-, medium- and large-sized lymphocytes) and plasmocytes (Fig. 6). Also, abundant eosinophils with numerous uniform spherical granules and bilobed nucleus were seen in 9 cases out of 32 (28.125%) of the tumours (Fig. 6). Rarely, invasive tumour cells stimulated stromal fibrosis.

In addition to neoplasms of squamous cell epithelium of the eye, a case of malignant hemangioendothelioma (Fig. 10) and a case of ocular lymphosarcoma were also diagnosed.

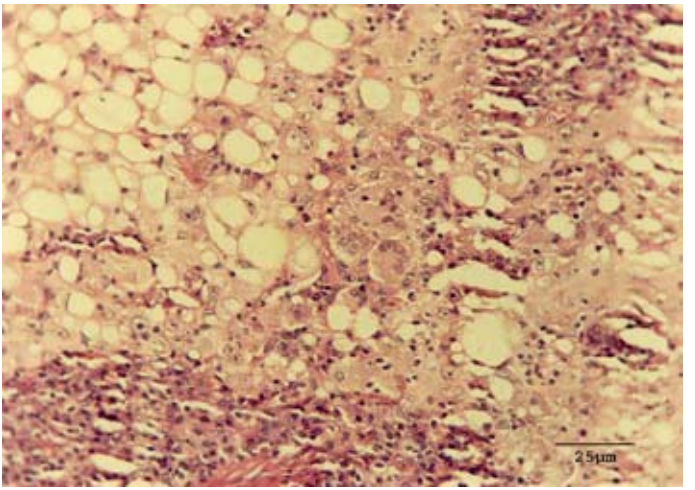

Fig. 8. Tissue section from poorly differentiated bovine ocular squamous cell carcinoma (G_3). Poor spinous differentiation, small-sized islands formation, vaculation of neoplastic cells and a few neoplastic bizarre giant cells are present. H&E; ×768.

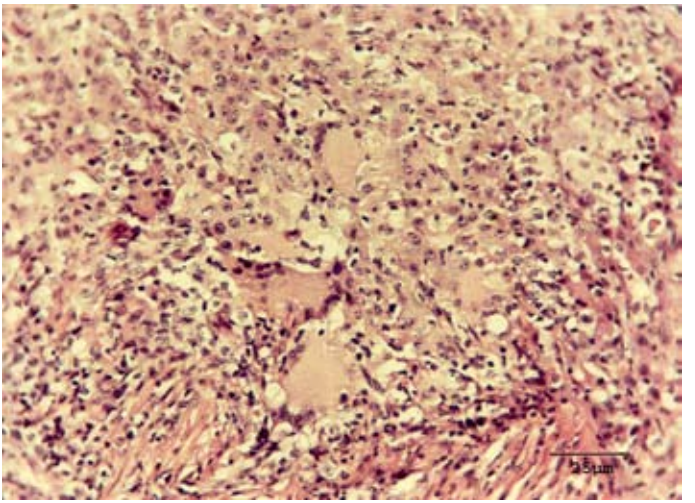

Fig. 9. Anaplastic ocular carcinoma of the bovine (G_4). Small hyperchromatic or spindle cells, lake of keratinization and a few neoplastic giant cells are seen. H&E; ×768.

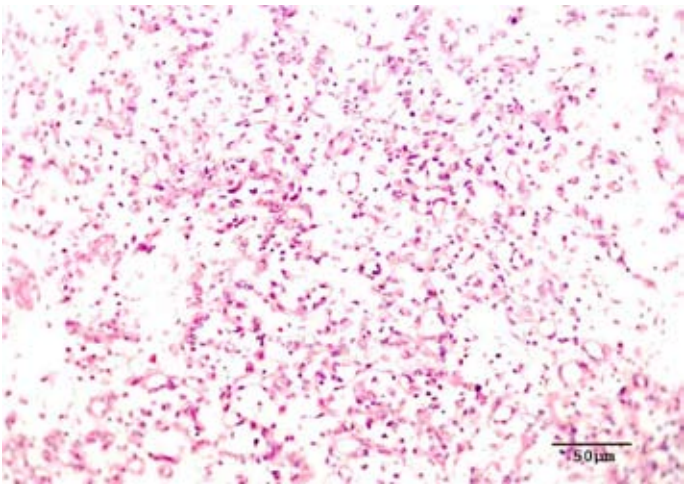

Fig. 10. A tissue section from hemangioendothelioma of the bovine eyelids. Large numbers of neoplastic vessels are seen. H&E; ×400.

Discussion

In Iran the majority of cases of bovine ocular squamous cell carcinoma were observed in areas with warm and dry climatic conditions, as in Tehran province, especially in summer.

Despite the fact that incidence of bovine ocular neoplasms varies geographically in our country, the Holstein-Friesian breed is thought to be the most susceptible. Greater exposure to sunlight in warm and dry areas was a predisposing factor, but it must be mentioned that Holstein-Friesians outnumber all other breeds of range cattle in Iran.

In Zimbabwe, ocular squamous cell carcinoma was frequently observed in Simmental cattle, and exposure to intense solar radiation has been proposed as the cause, especially when cattle are kept at a high altitude (1500 m) in a sunny and warm climate (RADOSTITS et al., 2000). According to the results of SLOSS et al. (1986), the season was important in progression of lesions and occurrence of new lesions of ocular neoplasms, and these were highest during summer and lowest during winter. It is suggested that because of exposure to more sunlight, the tumour is most common in beef cattle than in dairy cattle (RADOSTITS et al., 2000). However, there is a significant association between increasing risks of developing eye cancer and increasing levels of actinic radiation, and cattle exposed to high levels of radiation develop the disease at younger ages (ANDERSON and BADZIOCH, 1991; JONES et al., 1997; WILCOCK, 1993; DUBIELZIG, 2002; CORDY, 1990;

RADOSTITS et al., 2000; ROBERTS, 1996). Areas at higher altitudes and longer hours of sunlight have a higher incidence of cancer eye (ROBERTS, 1996).

Although a common tumour, the genesis of bovine OSCC has not been fully investigated and several theories have been advanced to explain its development (HAMLET and LAVIN, 1987). Non-pigmented body coat, light brown pigmentation of the iris, hot-iron branding, high nutritional status and hereditary factors are also predisposed as etiological factors associated with squamous cell carcinoma (ANDERSON and BADZIOCH, 1991; BHUME et al., 1992; DEN-OTTER et al., 1995; JONES et al., 1997; DUBIELZIG, 2002; O'TOOLE and FOX, 2003; RADOSTITS et al., 2000). In this study all animals were black and white Holstein-Friesian cow and had periorbital black skin. DEN-OTTER et al. (1995), showed more development of these tumours in Simmental cattle with periorbital white skin than in cattle with periorbital pigmented skin, whilst prevalence of OSCC was lower in other breeds of cattle (e.g., Friesian) that were partly white-faced and lived in Zimbabwe in a comparable environment. Selective breeding for increased pigmentation in and around the eye and protection of cattle against the harmful effects of incident UV radiation and developing cancer eye has been suggested (ANDERSON and BADZIOCH, 1991). It is suggested that melanin plays a photo-protective role in epidermal and mucosal surface (KOBAYASHI et al., 1998; KROL and LIEBLER, 1998; ORTONNE, 2002).

In this study, age range of the affected animals was 2.5-9 years (median 5 years) and 16 cases out of 26 (61.53%) animals which had available age were aged ≥5 years. The tumours were not common in animals younger than 3 years (7.6%) and were rare in animals less than 1 year of age (0%). In this regard the average age of cattle with ocular squamous cell carcinoma is 8 years (CORDY, 1990) and the tumours are uncommon in cattle younger than 5 years and rare and hardly ever seen in cattle younger than 3 years (RADOSTITS et al., 2000).

According to our results, the sites of ocular tumours were limbus and cornea (6.25%) and conjunctiva, or skin of the eyelids and nictitating membrane (71.88%), and in 21.88% of cases the eyeball was destroyed by the tumour. These findings disagreed with those of RUSSELL et al. (1956) and MONLUX et al. (1957). These reports have indicated that approximately 75% of ocular carcinomas and precursor lesions were found on the limbus and cornea and only the remainder (25%) were observed in the conjunctiva of the eyelids and nictitating membrane. In Hereford cattle, the most common sites of OSCC were the lateral (66.7%) and medial (16.5%) corneoscleral junctions (RUSSELL et al., 1976).

The distribution of tumours between right (40%) and left (37.5%) eyes was approximately equal, while in 21.9% of cows with neoplasms, both eyes were affected. These findings support the observation of RUSSELL et al. (1976) and CARVALHO et al. (2005).They reported that the origins of 15 BOSCC included, eyelids, 7; third eyelid, 5; and complete ocular region, 3 cases.

In this study, lymphosarcoma and malignant hemangioendothelioma were found in 2 out of 32 cases (6.25%) of the neoplasms. Multicentric lymphoma in cattle regularly involves the eye, although the retrobulbar tissue is preferred over the eye itself. Lymphosarcoma is the most common secondary tumour of the orbit and adnexa and is a common cause of exophthalmia in cattle, but on the basis of reports, intraocular invasion of lymphosarcoma in the bovine is rare (CORDY, 1990; RADOSTITS et al., 2000; ROBERTS, 1996; WILCOCK, 1993). In our investigation, in case no 32 the eye was involved as a part of a generalized disease, and periorbital and intraocular tissues were invaded by neoplastic lymphocytes. Also, malignant hemangioendothelioma was reported from the bulbar conjunctiva of a cow. A wide range of neoplasms has been reported to occasionally affect the conjunctiva or adnexa of domestic animals. Other than meibomian adenoma, squamous cell carcinoma or papilloma and melanoma, all other neoplasms are uncommon to rare (BLODI and RAMSEY, 1967; CORDY, 1978; WILCOCK, 1993). Also, ocular carcinomas are reported more frequently than sarcomas. This probably reflects the greater prevalence and metastatic potential of carcinomas (WILCOCK, 1993).

Secondary changes, such as necrosis, ulceration and inflammatory cell infiltration appeared in most carcinomas. Tumour invasion is almost always accompanied by an intense lympho-plasmocytic infiltration, presumably the host response to tumour antigens (WILCOCK, 1993). In 9 cases (28.13%) with squamous cell carcinoma reported in the present study, in addition to lympho-plasmocytic infiltration of tumour, numerous eosinophils were also present. Characteristic features of these cells were similar to those described by DELLMANN and EURELL, (1998).

It would appear that extensive infiltration of eosinophils to stroma of the ocular squamous cell carcinomas is a rare finding and one not reported by others. The real reason for this phenomenon is not defined, but may result from spontaneous tumour regression.

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SAŽETAK

Cilj istraživanja bio je prikazati pojavu očnih novotvorina u tijeku dvije godine u približno pet tisuća mliječnih goveda držanih na osam mliječnih farmi u okolici Teherana. Prikazane su osnovne značajke životinja, tip uzgoja i klimatski uvjeti. Tumori su bili kirurški uklonjeni te pretraženi makroskopski i mikroskopski. Novotvorine oka ustanovljene su u 32 goveda od kojih je više od 50% bilo starijih od pet godina. Promjene su u većini slučajeva (70%) bile smještene na trećoj očnoj vjeđi i spojnicama. Intraokularne promjene zabilježene su u sedam slučajeva (21,87%). Mikroskopski je u 12 (37,5%) slučajeva ustanovljen neinvazivni skvamozni karcinom ili karcinom in situ, u 18 (56,25%) invazivni skvamozni karcinom, u jednom (3,12%) je ustanovljen limfosarkom te također u jednom (3,12%) slučaju bio je ustanovljen maligni hemangioendoteliom. Stupanj malignosti za svaki tumor bio je određen na osnovi literaturnih opisa. Većinom je dijagnosticiran skvamozni karcinom, pretežno smješten na trećoj očnoj vjeđi i spojnicama vjeđa.

Ključne riječi: skvamozni karcinom, govedo, patologija