PATHOLOGY OF THE EYE IN CATTLE BEARING CARCINOMA OF THE MUCOSA OF THE ETHMOID

BY

C. J. JOSE

DISSERTATION

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Faculty of Veterinary and Animal Sciences
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DECLARATION

I hereby declare that this dissertation entitled "PATHOLOGY OF THE EYE IN CATTLE BEARING CARCINOMA OF THE MUCOSA OF THE ETHMOID" is a bonafide record of research work done by me during the course of research and that the dissertation has not previously formed the basis for the award to me of any degree, diploma, associateship, fellowship or other similar title of any other University or Society.

Mannuthy,
29-7-1982.

C.J.Jose.

CERTIFICATE

Certified that this dissertation entitled "PATHOLOGY OF THE EYE IN CATTLE BEARING CARCINOMA OF THE MUCOSA OF THE ETHMOID" is a record of research work done independently by Sri. C.J.Jose under my guidance and supervision and that it has not previously formed the basis for the award of any degree, fellowship or associateship to him.

Name of the Guide :

Dr. K.M.Ramachandran,
(Chairman , Advisory Board).

Designation: Professor of Pathology (Project Officer).

Mannuthy,
29-7-1982.

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C O N T E N T S

INTRODUCTION

1. INTRODUCTION

Ethmoid carcinoma is an important emerging neoplastic condition in cattle which has gained economic importance in recent years especially in Kerala. Paranasal sinus tumours were first reported in Scandinavian countries, in the early part of this century (Stenstrom, 1915). Later sporadic incidence of the tumour has been reported in other parts of the country.

The incidence of paranasal sinus tumour was first reported in India in 1930, in Tamil Nadu (Muthappa,1930). Subsequently two cases were reported in Andhra Pradesh (Narayana, 1960; Sastri and Rao, 1964). The first case in Kerala was recorded in 1960. Later several cases were recorded in different species of domestic animals and focused attention on endemic nature and economic importance of the specific type of tumour in the state (Rajan *et al.* (1972). Following this several reports about the incidence of this condition were published from Tamil Nadu (Damodaran *et al.* (1974), Karnataka (Balasubramanian, 1975), Orissa (Nayak *et al.* 1979) suggesting the spread of this malady in other parts of India.

The endemic nature of the tumour and the geographical spread indicate that ethmoid carcinoma is a very serious economic problem of cattle in the state. The incidence

is also more in high producing crossbred dairy cattle, particularly in advance stage of pregnancy. The clinical symptoms produced by this deep seated tumour are insidious and are manifested only in the advanced stages of the growth. One of the most important clinical manifestations observed in this condition is exopthalmos either unilateral or bilateral. Detailed investigations have been made on other clinical manifestations of the disease, its pathobiology (Sreekumaran, 1980) immunological aspects (Vikram Reddy, 1981), enzymology (Dave, 1981) and cytology of the neoplasm (Vijayan, 1981) etc. However, no systematic studies have been made on the pathologic changes in the eye of cattle affected with ethmoid carcinoma. The present investigation was therefore, undertaken to make a detailed study of the ocular changes in cattle bearing ethmoid tumours, with special reference to the incidence, clinical changes, gross pathological changes, biometry alterations and variations in the intraocular pressure.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

Published reports on the pathology of the eye in cattle bearing ethmoid carcinoma are scanty. Moussu (1906) reported first that exophthalmos is one of the most important clinical manifestations in tumour bearing animals. Muthappa (1930) observed loss of vision of one of the eyes, in his cases. Exophthalmos was reported in bullocks affected with paranasal sinus tumours by David and Venkataraman (1940) along with other clinical manifestations. Dacorso and Faria (1962) noticed unilateral exophthalmos in bovines. Amaral and Nesti (1963) described lachrymation, progressive exophthalmos with expulsion of eye ball, in tumour affected cattle. Unilateral or bilateral exophthalmos was also reported by Narayana (1960), Petisca (1971), Rajan et al. (1972), Tokarnia et al. (1972) and Becker et al. (1972). Nair (1973) observed that the clinical symptoms began with lachrymation. Ocular congestion and progressive exophthalmia usually unilateral (26) or sometimes bilateral (10) were observed in his cases. Damodaran et al. (1974) reported lachrymation, unilateral or bilateral exophthalmos and blindness in tumour affected animals in Tamil Nadu. Unilateral (10) and bilateral (2) and bulging of the eyeball were the eye changes described by Balasubramanian (1975)

in Karnataka. In the cases described by Nayak et al. (1979) in Orissa, lachrymation, unilateral or bilateral exophthalmos with opacity of the eye were the prominent features. Protrusion of the eyeball was observed in a bullock in Andhra Pradesh by Sivaraman et al. (1979). Blindness and exophthalmos was also noticed by Pospischil et al. (1979) in cattle. Out of the seventyfive cases described by Sreekumaran (1980) in Kerala, 48 cases had unilateral or bilateral exophthalmos. Profuse lachrymation was the early symptom observed in such animals. Unilateral exophthalmos involving the left eye was noticed more commonly. Bilateral exophthalmos was recorded only in two cases. The protrusion of the eyeball varied in nature and extent. In certain instances it was perceptible only on close examination. In advanced cases, the eyeball protruded from the eye socket to a variable distance. The eyeball showed lateral or ventral deviation. In many cases reported by the author, the exophthalmos led to blindness of the affected eye. Later necrosis and ulceration supervened resulting in conjuctivitis and keratitis.

ANATOMICAL FEATURES OF THE BOVINE EYE

3. BRIEF GROSS ANATOMICAL FEATURES OF THE BOVINE EYE.

The eye is an optical instrument of living tissue, which relays information received in the form of light to analysing centers where it is passed for storage (memorization) or acted upon instantly. It is suspended within the orbit by muscles which also provide it with movement and by membranes which helps for the control of movement and protection.

3.1. Orbit.

The orbit is a bony fossa which separates the eye from the cranial cavity, surrounds and protect the eye. It is deeper with a great rim diameter than that of the other species. It is constituted by the following bones.

1. Sphenoid
2. Lacrimal
3. Frontal
4. Zygomatic
5. Palatine
6. Maxillary and
7. Ethmoid

The palatine and maxillary being below the periorbita. The medial wall is formed by the lacrimal and frontal bones and the orbital wing of the sphenoid bone. At the most

anterior part of the orbit just within the orbital margin is the lacrimal fossa from which runs the lacrimal canal. The sphenoid has a large external surface. The frontal bone overlaps the orbital wing of the sphenoid on its external surface with a narrow extension adjacent to the dorsal end of the pterygoid crest. This appears to divide the sphenoid into two parts. The anterior part bears a prominent crest running horizontally forward along with a wing of this bone which continues forward to join the ethmoid bone at the sphenopalatine foramen.

The posterior part of the orbital wing of the sphenoid contains the optic foramen and borders the orbitorotandum foramen medially. The temporal wing of the sphenoid is small but has a thick prominent pterygoid crest which fans out anterioventrally into the wider pterygoid process of the sphenoid.

The frontal bone provides nearly the whole of the orbital roof and part of the medial wall. It contains ethmoidal and the frontal foramina. The ethmoidal foramen is situated about an inch anterior and dorsal to the optic foramen a little within the ventral edge of the orbital portion of the frontal bone.

The lacrimal bone is usually large, constituting most of the anterior orbital wall. The fossa for the lacrimal

sac lies in the lacrimal bone close to the orbital rim and is relatively small. It is a very thin extension of the lacrimal bone bulging into the lower part of the orbit providing the roof of the maxillary sinus as well as part of the orbital floor.

The orbital rim is made up of three bones, the frontal providing the roof and the upper half of the laternal extension, the zygomatic providing the floor and the lower half of the laternal extension and the lacrimal forming the medial or anterior part of the rim. At the suture where the frontal and lacrimal bone join in a prominent notch and a further large identification of the rim exists alongside the fossa of the lacrimal sac.

3.2. Extraocular muscles are seven in numbers. There are four recti, two obliques and a retractor oculi.

All the four recti muscles (superior (dorsal) rectus, lateral rectus, medial rectus and inferior (ventral) rectus are flat have their origin around the optic foramen and orbital fissure and insert into the globe with aponeurotic tendons from the limbus.

The inferior and superior (ventral and dorsal) oblique muscles serve as rotators of the eye. The retractor oculi may be either a complete cone of muscle, the apex at the orbital fissure and the base at its insertions into the

globe, or it may be divided into four parts, two inserting on either side of the superior rectus and the other two on either side of the inferior rectus. The retractor oculi serves as a useful purpose in providing a protective mechanism for the eye.

3.3. Lacrimal gland.

It is seen in a fossa located in the dorsolatral area of orbit, just behind the orbital rim. It is a modified skin gland. There are two parts, a large orbital or superior and a small palpebral or inferior which are continous with each other posteriorly.

3.4. Harder gland.

The harder gland located nasally and/or posteriorly to the globe is considered to be associated with the nictitating membrane. The ducts empty on to the bulbar surface of the nictitating membrane. The function of the gland is supplementing or complementing lacrimal lubrication in relation to the third eyelid.

3.5. Nictitans gland.

It is closely wrapped around the cartileginous shaft of the nictitating membrane.

3.6. Eyeball.

The eyeball proper contain of three layers or tunics. (1) External fibrous tunic. The outer protective layer which, with the intraocular pressure gives the globe its definite semi-rigid shape. This layer can be linkened to the box of a camera.

a) anterior portion : Cornea.

b) posterior portion : Sclera.

Both of these parts are covered by conjunctiva which is represented by epithelium only over the transparent cornea.

2) Vascular tunic (Uvea). This layer provides for the nourishment of the eyeball and is composed of:

a) Iris

b) Ciliary body (Ciliary muscle and ciliary processes)

c) Choroid

3) Inner layer : Retina. A thin delicate membrane which is really an expansion of the optic nerve. All parts of the eye serve the purpose of protecting and maintaining the retina.

Within the eyeball are the principal structures referred to as:

1. the anterior chamber containing aqeous humor.

2. pupil - formed by action of the iris.
3. posterior chamber - containing aqueous and viterous humor.
4. Lens and its zonular attachments.
5. vitreous humor - a jelly like mass occupying the greater part of the ocular cavity and lying between the posterior surface of the lens and the retina. Its outer surface presents a thin, structureless condensation, the hyaloid membrane, which in turn is firmly attached to the posterior capsule of the lens.

Structures and areas include:

Bulbar conjunctiva - covers the globe proper.

Palpebral conjunctiva - lies the upper and lower lids. Limbus - the peripheral area 1 mm wide, which forms a transmission zone between the cornea and the conjunctiva sclera. It is rich in blood vessels and nerve endings like the conjunctiva.

Tenon's capsule - a dense connective tissue membrane which surrounds most of the eye and its muscles and is located between the bulbar conjunctiva and the under lying sclera. Episclera - a thin, spongy, vascular elastic membrane whose purpose is to provide nutrition to other parts of the almost avascular selera. It is contained

within Tenon's capsule and loosely attached to the globe by fibrous connective tissue.

Fornix (retrotarsal fold) - the transition portion of bulbar to palpebral conjunctiva forming a fold between lid and globe.

Cul-de-sac- the fold (pouch) formed by the junction of the palpebral and bulbar conjunctiva.

The average measurement of the globe in a fully grown ox are from 34 to 37 mm antero-posteriorly, 37 to 42 mm vertically and 38 to 43 mm transversely.

3.7. Sclera.

The sclera which is mainly collagenous and elastic varies considerably in shape and thickness. It surrounds the globe completely to the corneal margin.

3.8. Cornea.

The cornea is virtually a continuation of the sclera, but with a greater curvature, and complete transparency attained by more careful arrangement of its fibrous structure. The corneal tissue is entirely without blood vessels, it possesses dense nerve fibre flexuses and it is more sensitive to pain than any other parts of the eye. The cornea joins the sclera and conjunctiva, the epithelial layer becomes very much thicker.

Between the cornea and the lens is a clear fluid which is constantly draining and replenishing itself, known as aqueous fluid. Behind the lens and in the largest chamber of the eye is more viscous medium known as the vitreous which serves to keep the retina well established against the choroid to which it is not usually very adherent when deprived of support. A further factor in retaining a close adherence to the choroid, and in maintaining the shape of the globe is the intraocular pressure.

Although the two fluid within the eye (aqueous and vitreous) are similar in chemical composition, they have a marked physical difference. The aqueous is constantly being replaced whereas the vitreous is a gel and undergoes little change. The aqueous is composed principally of water with some dissolved solids similar to lymph but with a much lower protein content.

Although the vitreous is also mainly composed of water, the gel consistency is the result of the fluid being contained within a sponge like structure, most marked peripherally and along a central canal.

3.9. Uveal coat.

The choroid, ciliary body and iris which together from uveal coat or uvea, unlike the cornea are highly vascular.

The choroid and ciliary body are attached to the internal surface of the sclera.

3.10. Lens.

The crystalline lens is suspended by zonular ligaments which connect the ciliary body.

3.11. Retina.

The retina (the light sensitive coat of the eye) is really an invaginated extension of the brain to which it is connected by the optic nerve (2nd cranial nerve) which passes through the choroid and sclera into the orbit. The appearance of the retina in the living eye is known as the fundus oculi.

3.12. The optic nerve and chiasma.

The optic nerve or optic fibre tract consists of the axons of the ganglion cells of the retina. On leaving the eye they become myelinated and they are enclosed within a dural sheath continuous with that of the brain and therefore become a compact and enclosed pathway which has not connection with any other neural pathway until it reaches the cranial cavity. Once outside the orbit the two optic nerves meet and decussate with each other before distributing to the lateral geniculate bodies.

The optic nerve from the two eyes merge and cross at the chiasma.

3.13. The eye lids.

The two external eye lids, which carry protective lashes (cilia) at their margins, perform multiple functions. They exclude light from the eyes. They sweep away foreign bodies reaching the cornea. They spread lacrimal fluid over the cornea and they carry auxillary glands to supplement the lubricants from the larger orbital glands.

3.14. Nictitating membrane.

The nictitating membrane or third eye lid moves laterally or diagonally across the eye behind the external eye lids. It is transparant and so does not greatly interfere with vision when it functions. Its main purpose is to exclude or remove dust and foreign bodies to retain moisture and conversely to exclude excessive moisture without bringing the external eyelids into operation and thus obstructing vision.

3.15. Conjunctiva.

It consists of two parts, a bulbar and a palpebral which lie against each other after folding over at the fornix. This fornix, often considered as a third area of conjunctiva, is the site of entry for ducts from the lacrimal and auxiliary glands which discharge their secretions into palpebral area. The part of the conjunctiva in opposition to the globe (bulbar) is loosely attached

but anterior portion or palpebral conjunctiva is firmly attached to the tarsal plates of the eyelids.

3.16. The vascular system.

The main blood supply to the orbit is derived from the internal maxillary artery, which is a continuation of the external carotid artery. Two branches of the internal maxillary artery penetrate the periorbita and represent the external ophthalmic artery.

The venous tributaries converge towards the equator perforate the sclera and pass into the ophthalmic vein.

3.17. Nerve supply.

The nerve of the eyeball course toward the cornea between the sclera and choroid and form a flexus in the choroid and then the flexus gangliosus ciliaris on the ciliary body, which gives rise to the nerves for the ciliary muscle, the iris and the cornea.

Third (oculomotor) supplies motor fibres to : superior, inferior and medial recti muscles. Portions of the retractor oculi, inferior oblique, levator, splinter of iris, ciliary muscle.

Fourth (Trochlear) supplies the superior oblique.

Fifth (ophthalmic branch of trigeminal) supplies:

lids, conjunctiva, cornea, dilators of the iris.

Sixth (Abducens) supplies the lateral rectus and portions of the orbicularis muscle.

MATERIALS AND METHODS

4. MATERIALS AND METHODS

The animals maintained in the ICAR project (on ethmoid tumours) attached to the Department of Pathology, College of Veterinary and Animal Sciences were utilized for the present study. These animals were brought from different parts of Kerala State. After getting intimation from the animal owners through the local veterinarians, on the spot examination of the animals was done and confirmed cases of ethmoid carcinoma were brought to Mannuthy for detailed investigation. They were then registered and a # register number was alloted to each animal. The age, sex, breed and the clinical history were recorded. The clinical manifestations were observed in detail daily in the morning and evening till the animal died or destroyed.

A thorough and detailed examination of both the eyes were carried out, with regard to any abnormalities in the lacrimal discharge, colour changes in the cornea, conjunctiva, nictitating membrane, eyelids, exophthalmos, entropion, ectopion, blindness etc. The changes were recorded on every day morning and evening with regard to each animal.

Individual animals were examined with minimum restraint. Swellings, comparing the size of the eye, nystagmus, strabismus, position of the nictitating membrane, discharges,

size of the palpebral aperture, position of the lids in relation to the globe etc. if any were noted. The animal was also examined for determining acurately the lid relationship (entropion and ectropion) to the globe.

For the gross examination of the specific structures, the eye was cleaned and the secretions obscuring the globe and membranes were removed after noting the character of the secretion, whether mucoid, pureulent or stringy and tenacious. Then the thickness of the lids and position (ectropion or entropion) were noted. Condition of the margin whether swollen, crushed or ulcerated was also observed and recorded. Size of the opening, ability to open and close openings for the lacrimal drainage system etc. The caruncle in the medial canthus for the possible presence of hair follicle protruding from it was also noted. The palpebral conjunctiva was next inspected. Exposure of the conjunctiva of the lower lid was easily accomplished by placing a finger near the margin of the lid and pressing downward. Eversion of the upper lid for viewing the inner surface was done by grasping the centre, pulling away from the globe and then back and upward.

The situation of the globe proper in the orbit was then noted (exophthalmos, enophthalmos). The size of both eyes in relation to the orbit was observed and compared with one

another. Bulbar conjunctiva was examined for any oedema, anemia, jaundice, haemorrhage, congestion, follicles and hyperplasia. Whether the conjunctiva was smooth and dry or excessively moist was checked. The relationship of membrane nictitans to the globe was observed. The cornea was then examined for dullness, opacities, vascularisation etc.

The sensitivity was noted by touching it with a wisp of cotton thread or glass rod. The sclera was examined by opening the palpebral tissue as widely as possible with the fingers and by changing the head position. The depth of the anterior chamber (normal, shallow or increased) was noted. The aequous humour was examined for cloudiness, exudates pus or blood. The iris was examined for its mobility, colour, smoothness and texture, adhesion to the cornea or atrophy. The size, shape and position of the pupil were noted and compared to that of other eye especially its reaction to light stimuli. The lens was then examined (immediately behind the pupil) for intralenticular opacities, size, dislocation.

The intraocular tension was also noted approximately by digital palpation. The two index fingers were placed on the upper eye lid and globe was palpated by an alternating rolling motion of the fingers. Some idea of the degree of tension was then determined by comparison with a normal eye.

The accurate determination of intraocular pressure was made by using Schiotz tonometer. The instrument was applied after administration of 4% xylocaine as local anaesthetic to desensitise the cornea and make it receptive to the apparatus and also after the subcutaneous introduction of 2% xylocaine solutions as supraorbital nerve block to immobilising the lids. The gadget was then applied firmly to the centre of the cornea and the reading in the panel was recorded. The reading obtained was later corraborated with the functional table supplied with the instrument to derive the pressure in mm mercury.

After spontaneous death or sacrifice gross abnormalities in the eyes were recorded. Then both eyes were collected and preserved. Then the individual components of the eyeball were dissected and examined for gross pathological abnormalities. The periorbital connective tissue membrane- Tenon's capsule,periorbita, lacrimal gland, conjunctiva, descemet's membrane, lens, ciliary body, ciliary muscles, occular nerve, chambers. Aqueous and viterous cornea, sclera, optic nerve, blood vessels etc. were closely examined for any abnormalities.

The sinuses and the tumour mass were also examined in detail. The growth and the tumour tissue, the extent of its encroachment to the orbit and orbital structures etc. noted.

The biometry of the eye was noted during post-mortem examination. The distance from the anterior pole to the posterior pole transverse and verticular dimensions of the organs were measured with a vernier calliper.

R E S U L T S

5. OBSERVATIONS AND RESULTS

5.1. Incidence.

In the present investigation 18 cattle bearing ethmoid tumour were examined. These animals were brought from different parts of the State. The details of these animals were given in Table 1.

The incidence of eye involvement in cases of ethmoid tumour in cattle was assessed on the basis of reports or informations received from field veterinarians and cattle owners from different districts of Kerala.

The highest incidence of the tumour was found in the age group of 6-10 years (Table 2). The earliest case was recorded in a heifer aged 4 years. The frequency of the incidence was high in females (88%),2 cases were also recorded in males (Table 3).

The tumour was encountered in pure bred (3) and crossbred cattle (15). The incidence was more on the crossbred animals (83%) (Table 4).

Out of the 18 cattle bearing ethmoid tumour 17 animals had exophthalmos (94%), unilateral (82%), bilateral (18%) (Fig. 1, 2 and 3).

Out of the 17 animals which had eye involvement 14 showed unilateral exophthalmos (Table 5). The left eye was affected in 2 cases (14%) and the right eye in 12

cases (86%). Out of the three cases of bilateral exophthalmos 2 animals were blind on both eyes and in the other the left eye only showed blindness. In the two animals which showed unilateral left sided exophthalmos, both the left eyes were completely blind. But in the 12 cases which showed right sided exophthalmos, except in one animal all others showed blindness. Out of the three bilateral exophthalmos cases, ectropion was not observed in one animal. In two cases the left eyes showed ectropion. Among the 14 animals which showed unilateral exophthalmos, ectropion was seen in 12 cases. Out of the 20 eyes affected, 18 showed involvement of the cornea, in the form of either keratitis or opacity or both. Corneal opacity without keratitins was observed in two cases. Conjunctivitis was present in all animals except one.

5.2. Clinical manifestation.

The results of observation of the clinical manifestations are summarised in Table 6.

The ocular changes were manifested when the tumour mass encroached the orbit. The symptom started with lachrymation. Initially the discharge was clear watery. This was followed by proptosis or protrusion of the eyeball (exophthalmos). The globe appeared to be larger in size and there was a widening of the palpebral fissure. This was associated with

swelling around the globe, prominent hypertrophical membrane nectitans, dilated and eccentrically placed pupil, exposure keratitis and blindness.

5.2.1. Eye lids.

An outrolling or eversion of the lids were observed in 14 eyes associated with exposure of conjunctival surface and eversion of the punctum. Epiphora was prominent in certain cases with a reddened hypertrophoid surface. In 3 cases blepharitis were noticed with inflammatory oedema and reddening and thickening of the palpebral conjunctiva and lid margins with sticky discharge and blepharospasm (Fig. 2).

Membrane nictitans (third eyelid) was thickened, sometimes protruded and flushed producing a watery to mucoid discharge. The cow often exhibited discomfort and rubbed the eye causing corneal abrasions.

5.2.2. Lacrimal apparatus.

Signs of epiphora and occlusion of the lacrimal canal was common. Dacryoadenites and dacryocystitis were manifested in most cases. Xerophthalmos was observed in two cases.

5.2.3. Conjunctiva.

1. Active hyperæmia. Red eye with discomfort in 8 cases.

2. Passive hyperaemia - conjunctival vessels darker - 12 cases.
3. Anemia - pale pink conjunctiva and pearly white
4. sclera were seen in the advanced stage in most of the cases.
4. Chemosis - oedematous swelling of the bulbar conjunctiva - 12 cases.
5. Ecchymosis - Intraconjunctival and subconjunctival haemorrhages.
6. Conjunctivitis - seen in all affected cases except two.

In theearly stages it started with acute catarrhal conjunctivitis. There was clear watery fluid, prominent blood vessels and pinkish to reddish discoloration. Later the discharge became greyish white mucoid or mucopurulent in clots, strings or liquid form. The lids were swollen and raw. In advanced stage oedema of the conjunctiva was also noted.

In 8 cases there were chronic, catarrhal conjunctivitis where the palpebral conjunctiva was hypertrophic and velvety.

In three cases, the symptoms were very severe with heavier and thicker discharge and corneal involvement. There was excorination, sticking of the lids. The cornea showed varying degree of changes from a simple superficial

vascularisation to deep ulceration. This was accompanied by xerophthalmos.

In one case there was symblepharon - adhesion of the bulba r to palpebral conjunctiva.

5.2.4. Cornea.

The following changes were observed in the cornea.

1. Loss of transparency - partial or complete.
2. Engorgement of the circumcorneal vessels.
3. Vascularisation - superficial.
4. Cloudy deposits in the acqueous.
5. Ulceration.

The animals manifested severe pain, photophobia, lachrymation and blipharosphasm.

There were tiny white dots giving a stippled appearance in certain cases associated with conjunctivitis, blepharosphasm and ephiphora were also seen. In two cases, superficial degeneration was noticed with a granular, glistening, ground glass appearance. In 5 cases, there was drycornea, characterised by discomfort, blepharosphasm and photophobia and loss of usual glistening appearance. The conjunctiva in these cases became red, thickened and velvety and a sticky ropy secretion coming out. Few erosions and ulcers were also noticed in few cases.

In the opacity cases, a small segment or the entire cornea showed loss of transparency. In two cases the cornea cleared by the second week. Three forms of the opacity were noticed.

1. Nebula - faint and cloud like in 7 cases.
2. Macula - more pronounced with grey spots- 2 cases.
3. Leukoma - dense and white in 6 cases.

5.2.5. Sclera.

Localised inflammatory changes involving the peri-limbal area were noticed - Episcleritis in 2 eyes. The area was engorged and felt immovable. Staphylomma or ectasia of the sclera was seen in two cases. In these cases the scleral wall became uniformly thin and bluish discoloration was evident due to the bulging of the underlying uveal tissue.

5.2.6. Iris.

Anterior uveitis (iritis). Inflammatory changes to the iris and ciliary body - iridocyclitis - pain, photophobia, blepharospasm and increased tearing were manifested. The ciliary blood vessels were congested. Cloudiness of the cornea. Escape of acquous and corneal oedema. Turbidity of the acquous. Exudate in the anterior chamber - hypopyon. The iris appeared to be spongy, muddy and lusterless. The pupil showed contraction (miosis) due to distension of the blood vessels and irritation of the spincture muscles.

5.3. Intraocular pressure.

The data on intraocular pressure recorded in the 18 animals are presented in Table 8.

The pressure in the unaffected eyes varied from 12.2 mm to 26.6 mm. In the affected eyes the value ranged from 15.8 to 28.6 mm mercury. In the animal where there was no eye involvement the pressure was 20 and 19 mm mercury respectively for the left and the right eye.

5.4. Gross pathology of the eyes.

At autopsy, the eyeball was dissected out from the socket. Detailed close examination of the individual components were made after dissection. The details of the gross pathological changes were summarised in Table 7. Out of the 17 animals examined 20 eyes showed complete protrusion of the eyeball from the orbit. Fourteen unilateral and three bilateral. The left eye was affected in five cases and the right eye in 15 cases. There was blood tinged discharge with a thick layer of plastic exudate adhering to the cornea and surrounding tissues. Diffuse thickening of the cornea extending and involving the sclera was noticed (Fig. 4). In two cases there was caseo purulent exudate adhering to the eye ball and extending to the deeper structure. In others creamy yellow discharge with hyperamia and oedema around the sclera was noted.

5.4.2. Retina.

Focal petechial or echymotic haemorrhages are noticed in the layers.(1). In the vitreous on top of the retina-preretinal haemorrhage. (2). Blood confined within the nerve fibres - superficial retinal haemorrhage with flame shaped haemorrhage and (3). Deep focal retinal haemorrhages. (4). Subretinal haemorrhages within and beneath the retina.

Degenerative changes are observed in certain cases - retinopathy. Frank inflammatory lesions were not present.

Partial or complete separation of the retina from the choroid was noticed in two cases. In these cases the lens was deviated posteriorly towards the ciliary body or into the vitrous cavity.

5.4.3. Vitreous.

A cloudy haziness was noticed in two cases. In other cases there were haemorrhages stands of blood were seen associated with retinal detachment.

5.4.4. Lens.

Partial (subluxation) or complete (luxation), dislocation of lens was noticed in 6 cases. A tilting of one edge of the lens and displacement to a superior, inferior, medial (nasal) lateral (temporal) or anterior position. In two cases the ligamentous attachment was completely disrupted

and vacated the patellar fossa. In one instance the lens was displaced anteriorly with the anterior chamber in front of the iris and in another, posteriorly with the vitreous.

5.5. Ocular biometry in the tumour bearing cattle.

The measurements of the anterior, posterior, transverse and vertical dimensions of the affected and unaffected eyes were presented in Table 9. The anterio posterior dimension of the unaffected eyes varied from 30 to 42 mm. The values for the affected eyes ranged from 30 to 43 mm. The transverse dimensions in the unaffected eyes varied from 31 to 41 mm and that of the affected eyes ranged from 31 to 43 mm. The values for the vertical dimensions of the unaffected eyes ranged from 36 to 41 mm and for the affected eyes 35 to 42 mm.

D I S C U S S I O N

DISCUSSION

Eighteen cattle, from different parts of the State, affected with ethmoid carcinoma were subjected to detailed investigation of the eye involvement. Out of these 17 animals showed either unilateral or bilateral exophthalmos, with varying degree of clinical and gross pathological changes, involving the different components of the eye.

Exophthalmos in tumour affected animals was reported by Moussu (1906), David and Venkataraman (1940), Dacorso and Faria (1962), Amaral and Nesti (1963), Narayana (1960), Petisca (1971), Rajan et al. (1972), Tokarma et al. (1972), Becker et al. (1972), Nair (1973), Damodaran et al. (1974), Balasubramanian (1975), Nayak et al. (1979), Sriraman et al. (1979), Pospischil et al. (1979) and Sreekumaran (1980).

In the present study also, 94 percent of the animals showed either unilateral or bilateral exophthalmos. Eighty two percent of affected cattle showed unilateral exophthalmos. Among the previous workers, Dacorso and Faria (1962) reported about unilateral exophthalmos. In all other cases it was both unilateral and bilateral. In the present investigation also the exophthalmos was both unilateral (82%) and bilateral (18%). From the reports of the previous authors and the result of the present investigation

suggest that exophthalmos either unilateral or bilateral can be considered as a pathognomonic clinical manifestation of ethmoid tumour affected cattle.

Eighty six percent of the involvement was in the right eye. This observation was not in agreement with that of Sreekumaran (1980). In his cases the left eye involvement was relatively more. This may be attributed to the difference in the number of cases examined. But the result of all these investigations support the conclusion that the incidence of bilateral exophthalmos, is comparatively low.

In all the cases, studied in the present investigation, a correlatinn was also made between the spread of the neoplastic mass and the degree of exophthalmos. The tumour mass inva riably spread to the retrobulbar region and filled the orbit andp pushed the eyeball to cause protrusion. In these cases the degree of exophthalmos was directly related to the intensity of pressure exerted by the tumour mass on the eyeball.

In a few cases, the exophthalmos was due to the damage of the orbital structures especially the ocular muscles and suspensory ligaments of the eyeball in the orbit. When these structures are damaged there will be relaxation of the tension and the eyeball is protruded out of the socket.

Blindness was noticed in 90 percent of the affected eyes (18 out of 20). Blindness was reported by previous workers also(Muthappa (1930), Damodaran et al. (1974), Pospischil et al. (1979) and Sreekumaran (1980). In the present investigation, blindness was observed with or without other visible ocular changes, suggesting that the tumour can exert a primary or secondary influence for the loss of vision. The tumour mass could press the optic nerve causing damage to the nerve and retina and/ lead to blindness. Otherwise secondary infection might supervene the protruded eye components with severe inflammatory changes and ultimately resulting a blindness.

Eighty five percent of the involved eyes showed ectropion. This might be due to the cicatrial contraction, following the inflammatory changes. The affected eyelids were not able to close the eye properly and thus favoured further secondary infection causing severe inflammatory changes to the exposed parts.

The corneal changes were observed in 90 percent of the affected eyes, in the form of keratitis or opacities. Corneal opacity was described as a prominent manifestation of ethmoid carcinoma by Nayak et al. (1979). The reason for corneal changes, observed in the present investigation might be due to the secondary effect of the tumour,resulting from inflammation, ulceration, injury or adhesion. In two

cases of corneal opacity without keratitis observed in the present investigation the cause of opacity might be a later effect of these secondary changes.

Conjunctiva was involved in almost all cases. Episcrelits, anterior uveitis with euphora, creamy white or thick discharge from the eyes were the other clinical manifestations observed. These might be due to the secondary infection resulting from extension of the infected tumour tissue or from the outside.

The tonometry readings indicated an elevation in the intraocular pressure, in the affected eyes. To explain whether the glaucoma is of secondary or absolute type, further studies are to be carried out.

The gross pathological studies made on the tumour tissue, and the eye at autopsy helped to correlate and confirm many of the clinical manifestations. This also helpted to noted the ocular changes in the deeper parts if the eyeball and orbit and also for the ocular biometry.

In many instances, the tumour mass was pressing the optic nerve, particularly in the orbital and intracraneal part. Changes to optic disc, papilledema, neuroretinitis, retrobulbar or optic neuritis, retinal changes might be the causes for the primary blindness observed in the

present cases. The lens as such was not involved in any of these cases except a partial or complete luxation.

The biometry studies did not give any clue of significant alterations in the dimensions of the involved eye.

SUMMARY

SUMMARY

Eighteen cattle from different parts of Kerala, affected with ethmoid carcinoma were subjected to detailed investigations of the ocular changes. The incidence of eye involvement in cases of ethmoid tumour in cattle was assessed on the basis of reports or informations received from field veterinarians and cattle owners from different districts of Kerala. Incidence, clinical manifestations, intraocular pressure, gross pathological changes and biometry of the eye were studied. The effect of the tumour mass on the eye and the possible causes for the different ocular changes has been discussed.

The highest incidence was found in the age group of six to ten years. The earliest case was recorded in a heifer aged four years.

The frequency of the incidence was high in females (88%). Crossbred animals were found to be more affected (83%). The tumour was also encountered in three purebred cattle.

Ninetyfour percent of the tumour affected animals showed exophthalmos either unilateral (82%) or bilateral (18%). The left eye was affected in 14 percent and the right eye in 86 percent cases. It is suggested that

exophthalmos can be considered as a pathognomonic clinical manifestation for ethmoid tumour affected cattle.

Blindness was observed in 90 percent of the affected eyes, ectropion in 85 percent cases and corneal changes in the form of keratitis or opacities in 90 percent cases. Episcleritis, anterior uveitis, euphora, purulent discharges were the other clinical manifestations.

Glaucoma, was found to be a characteristic feature in ethmoid carcinoma.

Involvement of the optic nerve, optic disc, retina, vitreous and other deep structures of the eyes were also noticed by gross examination of the whole eye at autopsy. The lens showed varying degrees of displacement or luxation.

TABLES

Table 1. Details of tumour affected animals examined.

Sl No	Animal No	Locality	Age	Sex	Breed	Eye involvement
1	200	Pattambi	8 yrs	M	crossbred	+
2	201	Mannarsala Haripad	7 yrs	F	crossbred	+
3	202	Kudappanakunnu	8 yrs	F	purebred	+
4	203	Kudappanakunnu	7 yrs	F	crossbred	+
5	205	Mannamangalam	4 yrs	F	crossbred	+
6	206	Chalakudy	7 yrs	F	crossbred	+
7	207	Kalamassery	8 yrs	F	crossbred	+
8	210	Chalissery	8 yrs	F	crossbred	+
9	211	Perumbavoor	6 yrs	F	crossbred	+
10	212	Chelakkottukara	9 yrs	F	crossbred	+
11	213	Chalakudy	9 yrs	F	crossbred	-
12	214	Varapuzha	7 yrs	F	crossbred	+
13	215	Wadakkanchery	10 yrs	F	crossbred	+
14	216	Kunnamkulam	8 yrs	F	crossbred	+
15	217	Thripunithura	9 yrs	F	crossbred	+
16	218	Ollukkara	9 yrs	F	crossbred	+
17	219	Thiruvazhamkunnu	8 yrs	F	purebred	+
18	220	Kottekkadu	7 yrs	M	purebred	+

Table 2. Age distribution of tumour affected animal.

Below 6 yrs	6 to 10 yrs	Above 10 yrs	Total
1	17	-	18

Table 3. Sex distribution of the tumour affected animal.

Male	Female	Total
2	16	18

Table 4. Breed distribution of tumour affected animal.

Purebred		crossbred	local	Total
Jersey	Swiss Brown			
1	2	15	..	18

Table 5. Eye involvement : Exophthalmos.

Unilateral		Bilateral	Total
Left	Right		
2	12	3	17

Table 6. Clinical Manifestations.

Sl No	Animal No	Lachry-mation	Purulent discharge	Opacity & Keratitis	Conjunc-tivitis	Blindness Left	Blindness Right	Protrusion Left	Protrusion Right	Entro-pion	Ectro-pion.
1	200	+		+	+	+	+	+	+		+
2	201	+	+	+	+	+		+			+
3	202	+	+	+	+	+		+	+		+
4	203	+			+				+		
5	205	+	+	+	+		+		+		+
6	206	+	+	+	+		+		+		+
7	207	+	+	+	+		+		+		+
8	210	+	+	+	+				+		
9	211	+	+	+	+		+		+		+
10	212	+	+	+	+		+		+		+
11	213										
12	214	+	+	+	+		+		+		+
13	215	+q	+		+		+		+		
14	216	+		+	+		+		+		+
15	217	+	+	+	+	+		+			+
16	218	+	+	+	+		+		+		+
17	219	+		+	+		+		+		+
18	220			+		+	+	+	+		

Table 7- Gross pathological changes in the eye.

Sl No	Animal No	
1	200	Left Eye: Complete protrusion of the left eyeball. Bloody discharge from the ~~ye~~ eye. Thick layer of plastic exudate adhering to the cornea and surrounding tissue. Scattered areas of congestion. There was diffuse yellowish discolouration of the cornea and it was completely displaced by yellowish tissue. Right Eye : Apprantly normal.
2	201	Left Eye: Diffuse thickening of the cornea extending and involving the sclera. There was almost complete de/pigmentation. The cornea and surrounding sclera was dark brown and diffusely thickened. Right Eye: Normal.
3	202	Left Eye: Purulent discharge. The eyeball was completely protruded. The cornea was covered with brownish exuda te. The periphery of the sclera was hyperaemic and thickened. Right Eye: Apparantly normal. But slight protrusion was present.
4	203	Left Eye: Normal Right Eye: There was lachrymation, protrusion and conjunctivitis present.
5	205	Left Eye: Normal Right Eye: Purulent discharge and bloody discharge. Maggots were present. The cornea was highly thickened. The sclera was thickened and hard and also hyperaemic. There was complete protrusion of the eye. Keratitis was present.

6 206 Left Eye: Apparantly normal.
Right Eye: The eyeball completely protruded. There was diffuse thickeneing enlargement of the sclera. The cornea covered with plastic brownish exudate in portions. The cornea was replaced by thick bnownish black keratinised tissue. The cornea was ulcerated leaving behind a deep depression. Caseopurulent exudate was seen adhering to the ulcerativ portion. The whole tissue was impaired by maggots.

7 207 Left Eye: Normal.
Right Eye: ~~Diffusely dull~~ There was protrusion of the eyeball. The cornea was completely replaced by a thick layer of gelatinous exudate which was firmly attached to the sclera. The periphery of the cornea and sclera was hyperaemic.

8 210 Left Eye: Normal.
Right Eye: Diffusely dull, opaque, rough and collected with sherds of fibrin. Cornea has became smaller and surrounding areas were involved by fibro-vascular tissue.

9 211 Left Eye: The sclera around the cornea was moderately and diffusely hyperaemic.
Right Eye: Complete protrusion. The eyeball was collapsed. The cornea was completely replaced by a thick layer of gelatinous exudate which was firmly adherent to the sclera. The periphery of the cornea and sclera was hyperaemic, thickened and wrinkled.

10 212 Left Eye: Normal
Right Eye: Sefere exophthalmos of the right eye. The cornea was bulged out, swollen and creamy yellow in colour. The surrounding sclera was moderately thick and hyperaemic and edematous. The cornea was shrunken in size and volume. There was central depression in the cornea and the region covered with thin membrane.

11 213 Left Eye: Normal
Right Eye: Normal

12 214 Left Eye: Normal
Right Eye: Complete protrusion of the right eyeball. Complete opacity of the cornea. The periphery of the cornea and sclera were hyperaemic and oedematous.

13. 215 Left Eye: Normal
Right Eye: Purulent discharge. Protrusion and conjunctivitis were present. Sclera was oedematous and thickened.

14 216 Left Eye: Normal
Right Eye: There was protrusion and lachrymation conjunctivitis present. Cornea was thickened and opaque.

15 217 Left Eye: Complete protrusion of the eye ball. Opacity of the cornea. Sclera was thcikened and hyperaemic.
Right Eye: Normal.

16 218 Left Eye: Normal
Right Eye: Slight enlargement of the eye ball. Protruding through the eye socket. A patchy area of opacity about one centimeter in diameter in the centre, extending towards the periphery. The right half of the cornea was diffusely opaque. Hyperaemia of the conjunctiva.

17 219 Left Eye: Normal
Right Eye: Moderate diffuse oedema of the sclera. Slight diffuse opacity of the cornea and focal areas of keratitis. The cornea was reduced in size and was encircled by diffusely oedematous sclera.

Table 8. Intra ocular pressure in mm. mercury.

Sl No	Animal No	Left Eye	Right Eye	Left Eye	Right Eye
1	200	+	+	17.3	20.6
2	201	+		18.5	26.6
3	202	+	+	24.4	28.6
4	203		+	20	19
5	205		+	14.6	15.8
6	206		+	12.2	14.6
7	207		+	14.6	17.2
8	210		+	16	15
9	211		+	14.8	16.4
10	212		+	18	17
11	213			20	19
12	214		+	18	16
13	215		+	18	20
14	216		+	14.5	16.5
15	217	+		24	18
16	218		+	16	18
17	219		+	16	18
18	220	+	+	20	21

Table 9. Biometry of the eyes in tumour affected animals in mm.

Sl No	Animal No	Left Eye	Right Eye	Left Eye			Right Eye		
				Anterio-posterior	Transverse	Vertical	Anterio-posterior	Transverse	Vertical
1	200	+	+	43	40	36	36	43	35
2	201	+		25	39	28	30	36	36
3	202	+	+	35	40	41	35	40	41
4	203		+	37	39	39	37	40	40
5	205		+	37	41	39	40	43	42
6	206		+	34	40	40	30	50	40
7	207		+	38	38	38	40	41	41
8	210		+	35	38	38	35	38	38
9	211		+	34	38	39	37	38	38
10	212		+	42	41	41	43	41	41
11	213			40	36	36	40	36	36
12	214		+	42	40	40	43	41	40
13	215		+	39	35	36	39	35	36
14	216		+	37	31	36	37	31	36
15	217	+		38	32	37	37	31	36
16	218		+	36	31	37	37	36	42
17	219		+	33	37	37	36	40	38

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PHOTOGRAPHS