

THE NORMAL MORPHOLOGY OF THE BOVINE EXTERNAL EAR IN RELATION TO BOVINE PARASITIC OTITIS

Semuguruka, W.D.¹, Gwamaka, M. ¹, Shayo, E.E.² ¹Department of Veterinary Pathology, Faculty of Veterinary Medicine, Sokoine University of Agriculture, P.O. Box 3018, Chuo Kikuu, Morogoro. ²Ministry of Agriculture and Cooperative Development, P.O. Box 9192, Dar es Salaam, Tanzania.

SUMMARY

The normal morphology of the bovine external ear was studied in five Friesian/Boran crosses. This was undertaken to see if the anatomy of the area might have some influence in the development of parasitic otitis in cattle as there have been some claims that some cattle breeds have a long and tortuous external ear canal which might predispose the animals to the parasitic otitis. It was found that the external ear canal was roughly round in cross section, had a straight course and a slight upward incline from the horizontal plane. Unlike the outer two thirds of the canal, the inner one third had no skin like features. This lining, with its nonkeratinised epithelium whose cells appear to be loosely arranged and an almost absence of glands in the subepithelium, has less protective qualities compared to that of the outer two thirds of the external ear. Such a lining would easily become infected after the slightest trauma. However, the superficial disposition of the vascular structures of the inner one third of the external ear allows for easy and faster access of defenses to the epithelium in case of infections.

INTRODUCTION

There has been a number of studies done on the ear infection of cattle that is generally known as Bovine Parasitic Otitis (BPO) (Jibbo, 1966; Lweno, et al, 1983; Msolla, et al, 1985, 1986, 1987;). However, not much has been written on the normal morphology of cattle ears, particularly the detailed histology of the external ear, that would help one appreciate the early and late histopathological changes in BPO. What is presently available on the normal histology of the external ear (Breazile, 1981) is a general

description that applies to most domestic animals and is therefore lacking in species detail about the lining epithelium at different levels and the morphological orientation of the ear canal in cattle.

There have also been views that some cattle breeds of (eg. the Zebu group) have a relatively long and tortuous external auditory canal and hence get BPO more easily than exotic cattle (Jibbo, 1966). These views need to be substantiated by a detailed morphological study of the bovine auditory meatus.

MATERIALS AND METHODS

Specimens for the study of the normal anatomy of the bovine external ear were obtained from 5, six to fifteen month old, male and female, Friesian/Boran cross cattle. Tissues were taken at nine sites along the entire ear canal and each specimen consisted of the entire thickness of the canal wall. All the specimens were fixed in buffered 10% formalin for later processing for microscopy.

Before specimens were processed for histology, those with bony tissues were decalcified in RDO (Du Page Kinetic Laboratory Inc., USA). All specimens were trimmed to appropriate size, dehydrated by passing in increasing concentrations of alcohol up to absolute alcohol, cleared in chloroform and embedded in paraffin wax. Sections were cut at 5 μ m thick using a Reichert - Jung microtome. All tissue sections were stained with hematoxylin and eosin (HE).

The bovine ear canal orientation and morphology were studied by serial sectioning, at 5mm intervals, with an electric saw along its entire length. The sections were then put together again on a thin wire probe in the same order of cutting, for directional orientation, circumferential outlining and depth of canal recordings.

RESULTS

Macroscopic Appearance

The auditory meatus was found to be roughly round in cross section and the lumen decreased in calibre as it approached the median plane. The external auditory meatus and the rest of the canal were not perpendicular to the saggital plane but had a slight upward incline from the horizontal plane(Fig. 1). The entire length of the meatus was straight . The length of the external auditory meatus ranged from 3.5cm to 4.5cm. Approximately two thirds of the outer part of the external meatus was supported by cartilage whereas the inner one third was supported by the temporal bone.

Microscopic Appearance

Pinna

The inner and outer surfaces of the ox pinna were similar to that of other animal species as described by Breazile(1981). In the ox, however, there were several cartilage plates at the base of the pinna and the plates were arranged in an alternating manner. However, no single cartilage plate formed a complete circle about the canal.

External Auditory Meatus

The histology of the outermost part of the meatus was similar to that of the pinna except that the epidermis was slightly thicker and there was slight formation of epidermal and dermal ridges (Fig. 2). Sebaceous and ceruminous glands were many in the dermis but hair follicles were few and became even less as the

osseous supported part of the canal was approached. They disappeared just before the osseous supported canal was reached.

Just before and just after the osseous supported external meatus, the lining epithelium was of two kinds (Fig. 2 and Fig. 3). Half of the circumference of the meatus was lined by a keratinised stratified squamous epithelium and in the subepithelial tissues there were no hair follicles, only few sebaceous glands but ceruminous glands were relatively more. The other half of the circumference had a nonkeratinised stratified epithelium with single or branching ridges invaginating into the subepithelium. In the subepithelium both gland types were few though the ceruminous glands were comparatively more evident. The rest of the osseous supported external meatus had only the nonkeratinised stratified squamous epithelium which had prominent single or much branching invaginating ridges (Fig. 3). The thickness of the epithelium was variable and the epithelial cells seemed loosely arranged. The subepithelial connective tissues ridges (in between the invaginating epithelium) was well vascularised such that blood vessels appeared very close to the epithelial surface. Sebaceous glands were absent here and very few ceruminous gland were seen; these disappeared all together in the last half (toward the tympanic membrane) of the osseous supported part of the meatus. Present in the compact subepithelial connective tissues here was a sparse

scattering of mononuclear cells, particularly the lymphocytes.

DISCUSSION

The observation that the external auditory meatus [EAM] has a straight direction with only a slight upward incline from the horizontal plane differs from that of Jibbo (1966) who had it that the EAM had a tortuous course. Although the finding that the EAM has straight direction was from a study in Friesian/Boran cross cattle, it is believed these represent both exotic and zebu breeds of cattle and probably most cattle breeds would have this kind of ear canal orientation. Thus the ease of development of Bovine Parasitic Otitis (BPO) observed in some a cattle breeds (Jibbo, 1966; Msolla et al, 1989) is likely due to factors other than the effect of anatomical orientation of the EAM.

Whereas Breazile(1981) describe the histology of the lining of the EAM in domestic animals, including cattle, as skin containing a few hair follicles, sebaceous and ceruminous glands, our study found this description to apply only to the outer two thirds of the EAM (that which is supported by cartilage). The inner one third of the EAM (supported by bone) has a lining which does not resemble skin. In fact the last half (toward the tympanum) of the osseous supported EAM has no glandular tissue. To some extent the histological appearance of the lining of the inner one third of the bovine

EAM resembles that in man except that the osseous supported portion of the EAM in man has hairs and glands along the upper wall (Flock, 1988). Certainly the lining of the bovine EAM differs from that of the dog and other carnivores in which hairs and glands are present throughout the EAM (Trautman and Fiebiger, 1952).

The histology of the outer two thirds of the bovine EAM is typical for those areas that are subject to trauma. However, the inner (osseous supported) one third of the EAM, with its nonkeratinised epithelium, somewhat loosely arranged epithelial cells, lack of hairs and sebaceous glands, has comparatively less protective qualities. This area would thus be easily vulnerable to infections compared to the outer two thirds of the bovine EAM. It has been observed by Semuguruka, et al (1998) that in the development of the lesions of BPO, the inner one third of the EAM lining develops a severe reaction when infection reaches the area than is the case with the outer two thirds (cartilage supported) EAM. However, blood vessels being close to the surface of the nonkeratinised epithelium of the inner one third of the EAM is advantageous in that defenses, via the blood, are likely to reach the epithelium quickly. Nevertheless the superficial position of the blood vessels at this site would predispose the area to easy traumatic bleeding or even easy vascular infection once the overlying epithelium is breached.

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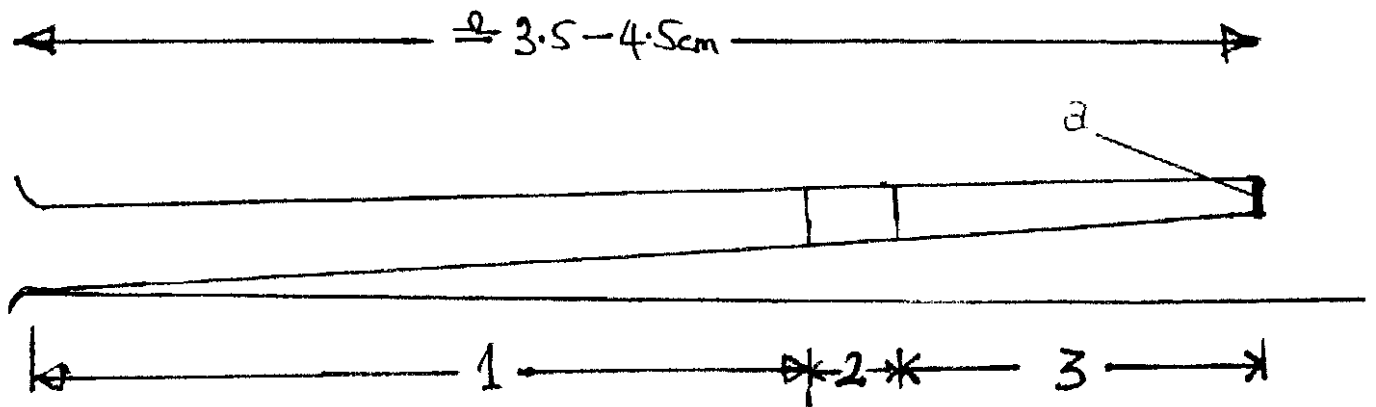


Fig. 1. Sketch showing the slight incline EAM from the horizontal plane. a = tympanic membrane. 1 = outer 2/3 of EAM; 2 = transitional area of EAM; 3 = inner 1/3 of EAM
EAM = External Auditory Meatus

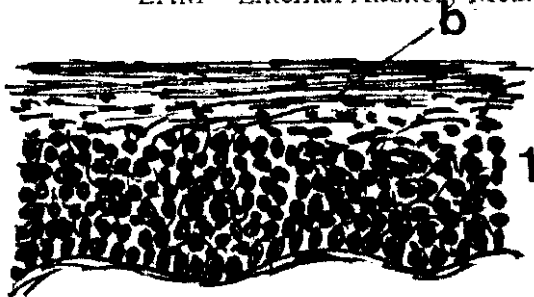


Fig. 2.

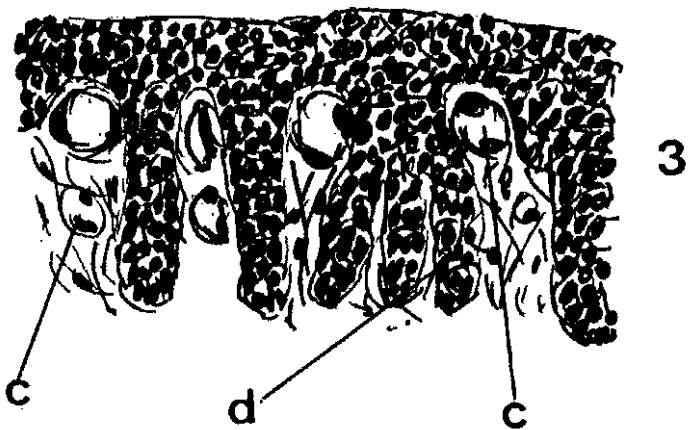


Fig. 3.

Fig. 2. Epithelium - outer 2/3 of EAM. 1 = keratinised stratified squamous epithelium. b = keratin layer.

Fig. 3. Epithelium - inner 1/3 of EAM. 3 = nonkeratinised stratified squamous epithelium. c = blood vessels, superficially placed. d = invaginating single or multiple branchings of the epithelium.