



Foot-and-mouth disease (FMD)

1- Foot-and-mouth disease (FMD) is a highly contagious viral infection of **all cloven-hoofed animals**, such as cattle, sheep and goats and pigs.

2- FMD is an **acute febrile condition** characterized by the formation of vesicles in and around the mouth, on the feet, teats, and mammary glands.

3- Species FMD virus (FMDV) belongs to genus Aphthovirus (aphtha = ulcer) in family Picornaviridae. (that is, affinity for epithelial cells).

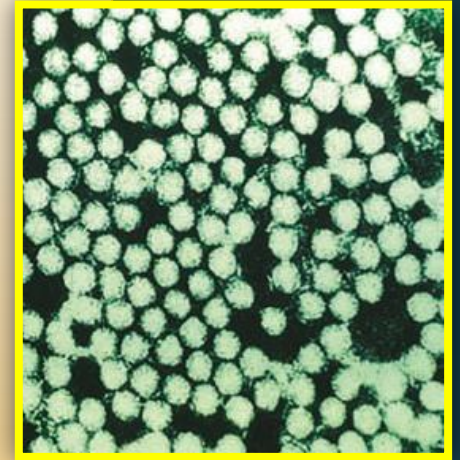
4- The virus is highly resistant under many circumstances, but is **inactivated by direct sunlight**, because of drying and increase in temperature, and by moderate acidity (pH <5.0).

5- The acid production that accompanies rigor mortis in carcasses and meat inactivates the virus.

6- However, the alteration in pH is not dependable and the virus survives in **viscera**, **lymph nodes**, and **bone marrow** for an indefinite period under refrigeration.

7- Of equal importance to the persistence of the virus is its **antigenic heterogeneity and instability**. There are 7 principal antigenic serotypes, namely, the classical A, O, and C types, and SAT-1, SAT-2, SAT-3, and Asia-1.

8- These serotypes are sufficiently different immunologically that **infection with one type does not confer resistance to the other six**. Within these 7 major types there are **antigenic subtypes**, each different, to variable degrees, from the parent type.





2 Intact vesicle on the tongue of a bovine.



5 Ruptured vesicles on the tongue of a bovine.

9- The main portal of entry and primary site of viral multiplication are **the epithelia of the pharynx and lung.**

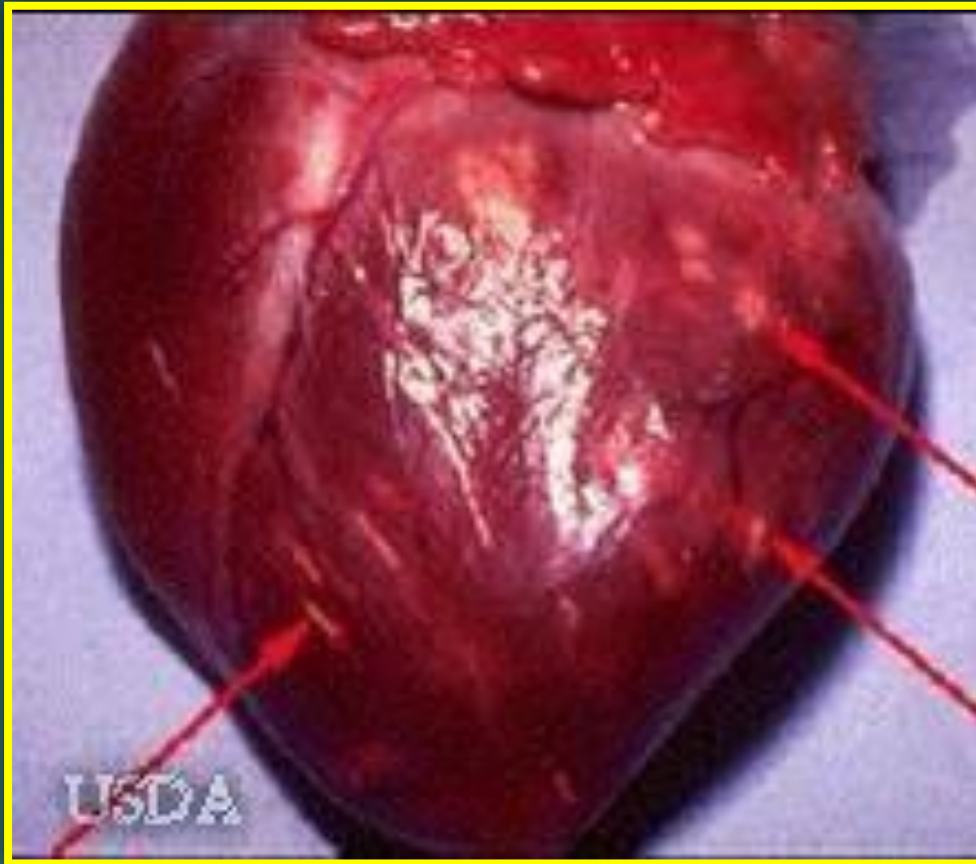
10- The resulting cellular degeneration and lysis result in an **epidermal vesicle**, which is the hallmark of the disease.

11- Lesions develop mainly in areas subject to trauma: the oral mucosa, especially the tongue; the interdigital cleft; and the teats in lactating animals.

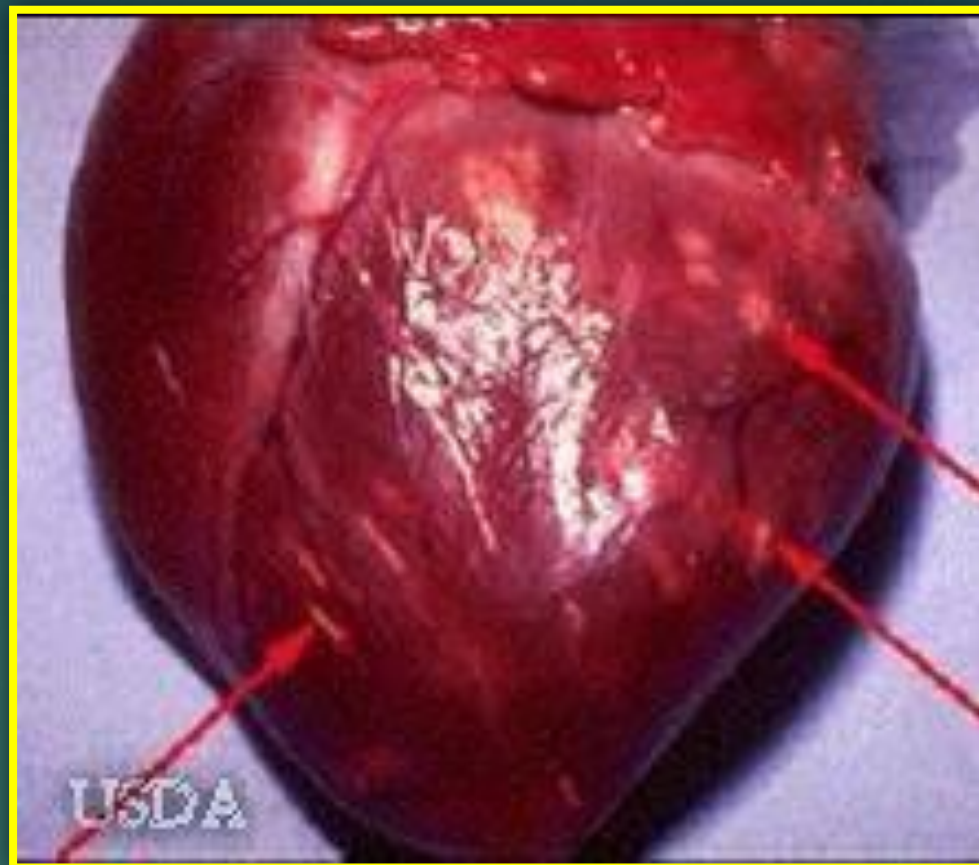




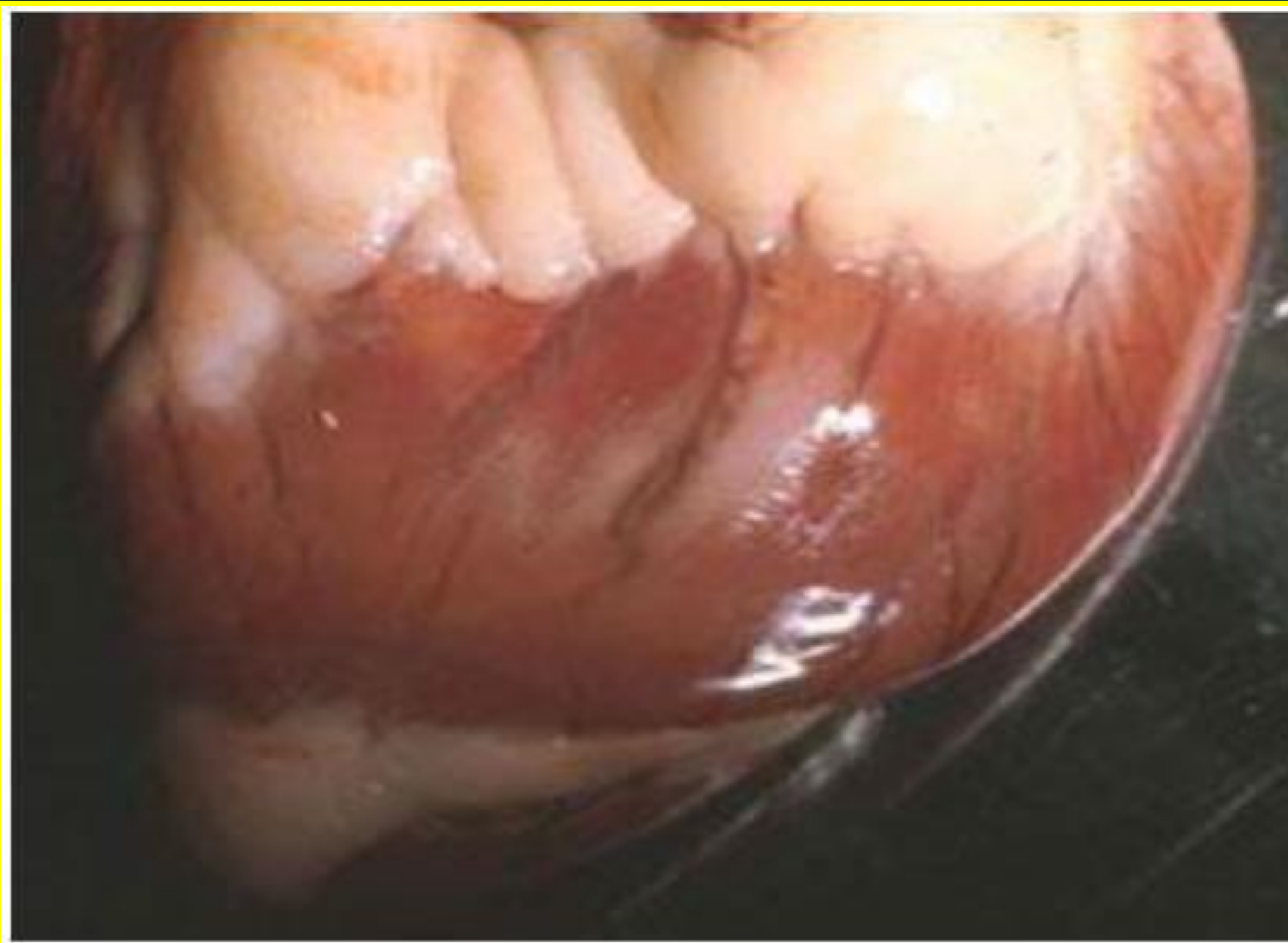
FMD: There is a ruptured vesicle on the end of the teat.



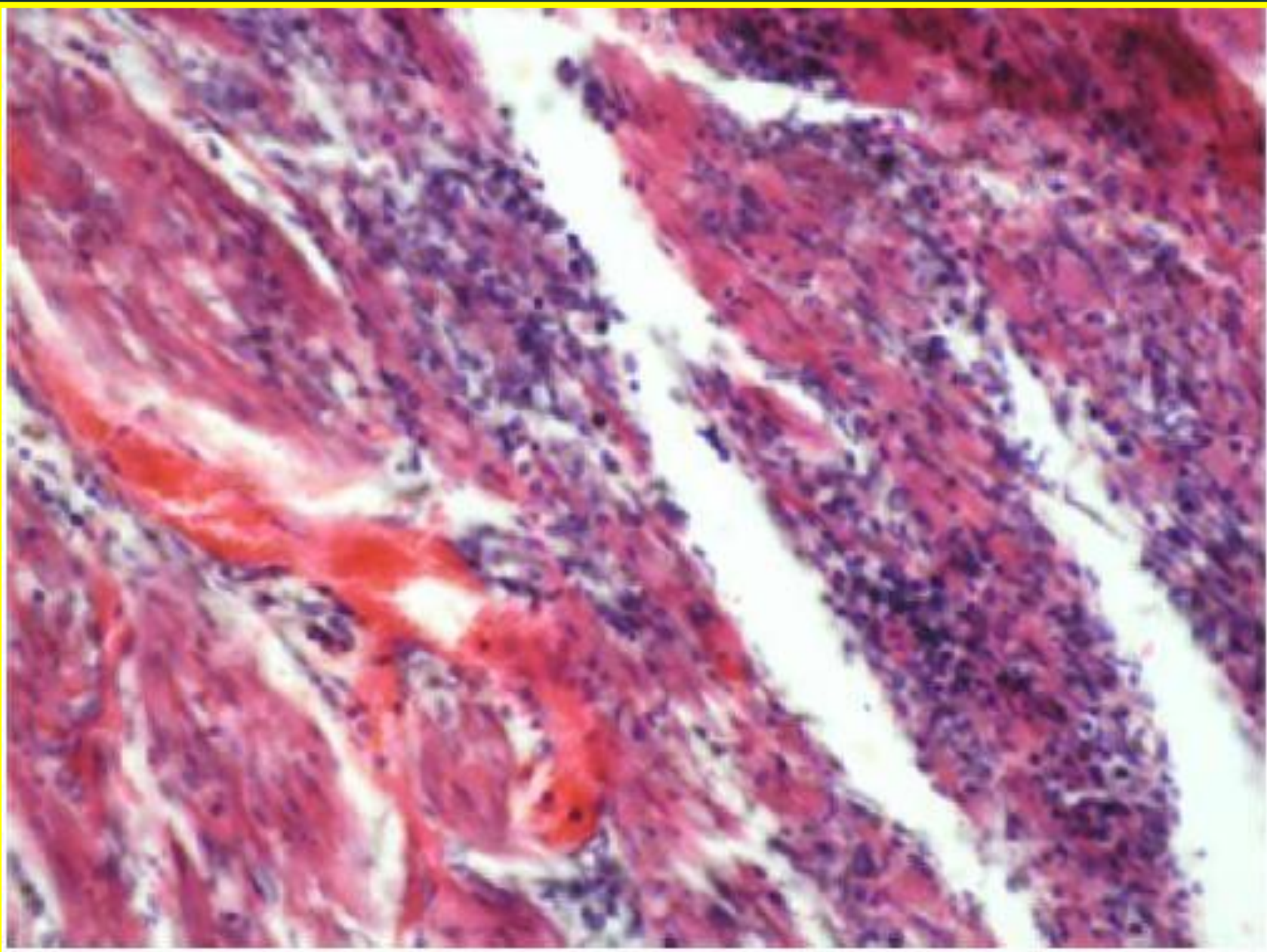
12- A malignant form of the disease, without vesiculation, does occur in young animals and occasionally in adults. In these, death is common, as a result of myocarditis.



13- Although historically referred to as “tigerheart,” these gross lesions are no different from those generated in any other syndrome of severe, acute myocardial damage, **but necrosis of fibers may be striking.**



FMD: There is a pale area of myocardial necrosis visible from the epicardial surface (Tigrion appearance)



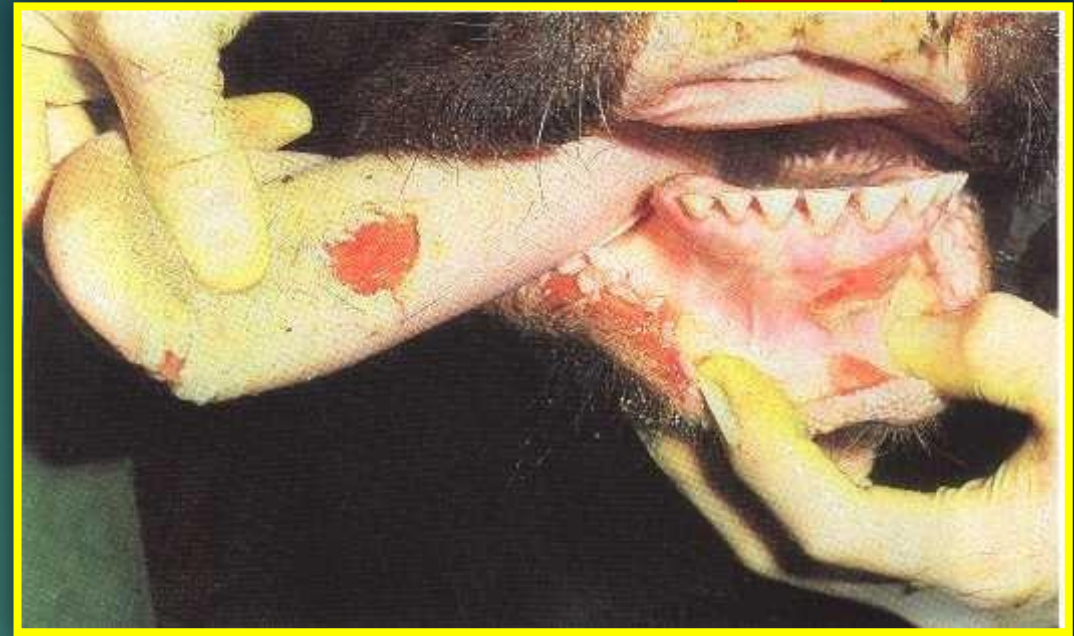
**Microscopic picture of myocardium of died calf infected with foot and mouth disease showing necrotic myocarditis infiltrated with lymphocytes.
H&E**

14- The disease is not notable for high mortality, except in sucklings, **but morbidity is very high**, with a concomitant loss of productive efficiency.



Foot-and-mouth disease. Ruptured vesicle on the gingiva of a cow.

15- In the living animal, there is diffuse buccal hyperemia and mild catarrhal stomatitis, **but the hyperemia disappears at death.**



16- Vesicles form on the inner aspects of the lips and cheeks, the gums, hard palate, dental pad, and **especially on the sides and rostral portion of the dorsum of the tongue.**





Cattle infected with FMD showing rupture tongue vesicles

17- The primary vesicles are small, but coalesce to **produce bullae which may be 5-6 cm across**; these bullae rupture in 12-14 hours, leaving an intensely red, raw, and moist base to which shreds of epithelium may still adhere.

18- The eroded to ulcerated area may be **replaced by regenerated epithelium in <2 weeks**. Secondary infection may complicate this course.



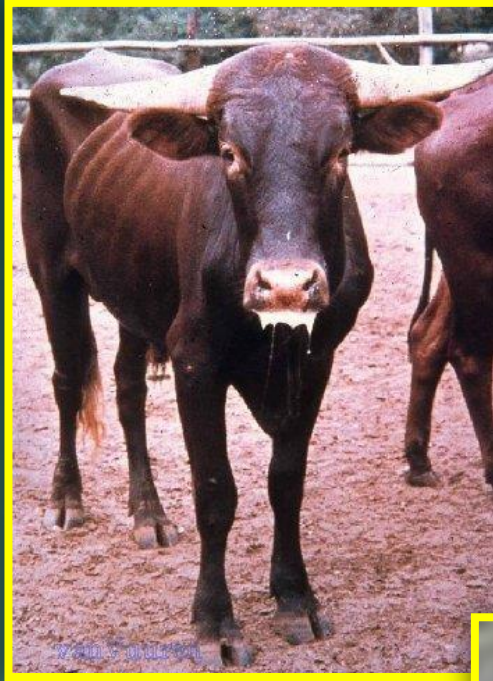
Vesicles on the snouts of two pigs.



Cattle infected with FMD showing rupture gum vesicles



19- a- In cattle, there is appreciable loss of weight and the buccal cavity may contain much saliva.





19- b- Cattle infected with foot and mouth disease showing excessive salivation resulted from oral lesions.



19- c- Cattle infected with foot and mouth disease showing excessive salivation resulted from oral lesions.



20- Vesicles form on the muzzle and exterior nares.



21- Foot lesions occur in the majority of cases. There is inflammatory swelling with blanching of skin of the interdigital space in ruminants, coronet in swine, and heels in all species

22- A day or so before vesicles form. The swellings persist until the vesicles rupture and the resultant erosions heal.





FMD: Rupture of vesicle leading to necrotic area in feet.





FMD: Rumen mucosa, higher magnification. There are several irregularly shaped erosions (ruptured vesicles) on the pillar.



FMD: Rumen mucosa, dorsal sac, low magnification. There are several irregularly shaped erosions (ruptured vesicles) on the pillars. The pale margins are undermined epithelium (vesicle remnants).

23- Carrier Animal & Virus Transmission:

- ▶ **Respiratory aerosols**
 - ▶ **Travel long distances**
 - ▶ **Proper temperature and humidity**
- ▶ **Direct contact**
 - ▶ **Vesicular fluid**
 - ▶ **Ingestion of infected animal parts**
- ▶ **Indirect contact via fomites**
 - ▶ **Boots, hands, clothing**

24- Definitive diagnosis requires virus isolation and characterization, demonstration of viral antigen by enzyme-linked **immunosorbent assay**, or detection of viral genome by **polymerase chain reaction** in lesional material.

25- FMD must be differentiated from other viral vesicular diseases such as **vesicular stomatitis**, **vesicular exanthema**.

Cattle: Rinderpest, IBR, BVD, MCF, Bluetongue.

Sheep: Bluetongue, contagious ecthyma.