

RINDERPEST



BASICS

OVERVIEW

- Rinderpest is one of the most feared viral diseases of cattle.
- Estimated that this disease caused the death of over 200 million cattle in Europe in the 18th century and 2.5 million cattle in the last Great African Pandemic in 1890s.
- Rinderpest was instrumental in the formation of veterinary schools throughout Europe.
- Only one serotype but many strains of the virus that vary in virulence.
- Currently (at the time of publication of this book chapter), rinderpest is eradicated from the face of the earth. At this time, the virus is being kept in some select secure government facilities throughout the world.
- Debate continues on when to destroy the remaining stocks of this virus. There is always concern that virulent strains of this virus may fall into the wrong hands and use this virus as an agro-terrorist weapon.

INCIDENCE/PREVALENCE

- Morbidity is often 90% to 100% and mortality is up to 90% in epidemic areas, but in endemic areas morbidity is low and clinical signs were often mild. Currently eradicated.

GEOGRAPHICAL DISTRIBUTION

- Eradication was declared world-wide in 2011

SYSTEMS AFFECTED

- Gastrointestinal – oral cavity, esophagus, abomasum, and intestinal tract.
- Hemolymphatic– tonsils, lymph nodes, spleen, Peyer's patches, lymphocytes

PATHOPHYSIOLOGY

- The disease is spread by direct contact with oculonasal fluids and feces. However, the virus can be identified in all tissues.
- Rinderpest replicates in the host cells' cytoplasm, with an affinity for tonsillar, lymphoid, and epithelial tissues.
- Rinderpest is highly immunosuppressive, causing a profound leukopenia and CD4+ T cell suppression. Secondary infections are common
- Affected animals develop a high fever, depression, anorexia, and diarrhea. Death usually follows. Ulceration of the oral mucosa and a necrotizing enteritis are common gross necropsy findings.

SIGNALMENT

- In endemic areas, rinderpest is mild and self-limiting. However, when the virus is introduced into naive animals, the virus seems to change in virulence resulting in a severe clinical presentation of the disease.

- All cloven-hoofed animals are susceptible to infection. European breeds of cattle (*Bos taurus*), Asian water buffalo (*Bubalus bubalis*) and the yak (*Bos grunniens*) are most susceptible. Zebu cattle (*Bos indicus*) are more resistant.
- Sheep and goats are susceptible to the virus but only get a mild form of the disease.
- Swine are susceptible to the virus.
- Camelids are susceptible to infection with the virus and can seroconvert. However, they are believed to not shed the virus.
- Most African wildlife are susceptible to the virus with the African or Cape buffalo (*Syncerus caffer*) being very sensitive to the virus.

SIGNS

- Rinderpest may present as an acute or subacute disease. Incubation period is between 7 and 14 days.
- Animals develop a high fever, 104°F to 107°F (40 to 42.2°C), and become depressed with anorexia. Milk production is severely curtailed.
- Mucus membranes of the mouth and conjunctiva become congested. The muzzle usually becomes dry, crusty and ulcerated.
- Animals occasionally become constipated early in the course of the disease followed by abundant runny diarrhea that may contain abundant mucus, fibrin and/or blood. The diarrhea may be so intense that tenesmus and abdominal pain may be observed.
- Small pinpoint areas of necrosis or shallow erosions are usually first noted on the lips and gums and later on the tongue, dental pad and plate.
- Vesicles may develop on the tongue.
- As the disease progresses, the animals become dehydrated, weak and prostrate; death often follows.
- In sheep and goats, clinical signs are variable. Animals may develop a mild fever (up to 104°F) with a mild ocular discharge and diarrhea. Oral ulcers may be observed.

CAUSES AND RISK FACTORS

- Viral disease caused by a morbillivirus that is closely related to Peste des petits ruminants (PPR), canine distemper and measles and is a member of Paramyxoviridae
- Three genetically distinct lineages of the virus which were found in Africa and Asia. These lineages are: Linage 1 (Africa), Linage 2 (Africa) and Linage 3 (Asia).
- Virus largely depended on continual transmission among domesticated cattle, domesticated buffalo, and yaks
- Wildlife also played an important role in rinderpest, particularly in Africa due to its greater population sizes and densities and larger number of susceptible species. However, wildlife could not maintain the virus alone and disease in wild species disappeared when it was eradicated from domestic cattle.



DIAGNOSIS

DIFFERENTIAL DIAGNOSIS

- Bovine viral diarrhea (Mucosal disease) (BVD-MD): Naive animals have fever, diarrhea and develop ulcers in oral cavity and esophagus. Necrosis of intestinal gut associated lymphoid tissue (Peyer's patches) can be seen. BVD can be identified by PCR probes on whole blood and spleen. Persistently infected animals can be identified by immunohistochemistry of skin biopsies and ELISA techniques on sera.

- Malignant Catarrhal Fever (MCF): Common finding in affected animals are severe erosion of the nasal mucosa, oral ulcerations, severe corneal edema, and conjunctivitis.
- Infectious bovine rhinotracheitis: Animals develop severe upper respiratory disease with ulceration of the tracheal and nasal mucosa. Occasional ulceration of the oral mucosa and esophagus is noted.
- Foot and mouth disease: Animals develop vesicles and ulcers on the lips, oral mucosa, tongue, teat, interdigital space and/or coronary band.
- Blue tongue (BT)/Epizootic hemorrhagic disease (EHD): Animals (mostly sheep for Blue tongue, and cattle for both blue tongue and epizootic hemorrhagic disease) can develop oral ulcers in the mouth with edema and ulcers of the muzzle. Laminitis/coronitis can occur.
- Bovine papular stomatitis: Parapoxvirus often characterized by single or coalescing proliferative lesions on the palate and tongue.
- Contagious Ecthyma (Orf): Parapoxvirus that develops prominent proliferative growths on the lips, oral mucosa (primarily gums and dental pad) and teats (primarily in sheep) that are easily ulcerated and bleed.
- Peste des petits ruminants: Disease of sheep and goats and closely related to rinderpest. Clinically animals present with ulceration of the oral mucosa, conjunctivitis, diarrhea, and pneumonia.

CBC/BIOCHEMISTRY

- Severe leukocytopenia is observed which may last for several weeks.

OTHER DIAGNOSTIC PROCEDURES

- Reportable disease in most countries. Animals suspected of having this disease must be reported to state and federal veterinary officials to insure that the disease is eradicated from the region.
- Complement ELISA, virus neutralization, complement fixation, and agar gel immunodiffusion techniques are useful serological tests commonly used to detect exposure to the virus.
- Virus isolation is best completed on freshly dead or killed animals. Submission of spleen, lymph nodes, tonsil, necrotic gum or oral mucosa should be submitted in a sterile sample container. Whole blood preserved in EDTA or heparin can also be submitted.
- Ocular and nasal secretions during early stages of the disease contain abundant virus. These secretions can be submitted in virus isolation media.
- Blood and tissues should be sent on wet ice and not with dry ice to the designated veterinary diagnostic laboratory for evaluation.

PATHOLOGICAL FINDINGS

- Gross Lesions include small shallow ulcers on the lips, tongue, palate, esophagus and rumen. Erosions may also be present in the vulva, vagina and prepuce. The abomasum is congested and occasionally hemorrhagic.
- Intestinal lesions are necrosis of the gut associated lymphoid tissues (Peyer's patches), ulceration of the colon and rectum and hemorrhage (zebra-striping) of the rectum and distal colon.
- The lymph nodes are often swollen and edematous.
- Petechial and ecchymotic hemorrhage and necrosis of the gall bladder are occasionally seen in diseased animals. \
- The lungs may also be emphysematous and congested with a mild interstitial pneumonia.

- Histological changes included necrosis of the mucosal epithelium of the oral, esophageal and ruminal mucosa with multinucleated syncytial cells present in the epithelium. Intranuclear and intracytoplasmic inclusions may be present in the syncytial cells.
- Lymph nodes, spleen, and gut associated lymphoid tissue (Peyer's patches) have severe lymphoid necrosis with occasional syncytial cells present. Intranuclear and intracytoplasmic inclusions may occasionally be identified in syncytial cells and some degenerate and necrotic lymphocytes.
- The small and large intestine have necrosis of the crypts with flattening of the villi.
- Occasional syncytial cells can be noted in the glandular crypts. Intracytoplasmic and intranuclear inclusions can occasionally be observed in the syncytial cells and enterocytes (often early in the disease progression, later in the disease inclusions may be absent).



TREATMENT

THERAPEUTIC APPROACH

- Since this disease is eradicated, euthanasia of affected animals would probably be recommended to prevent further spread of the disease.
- However, if one is to treat affected animals, intensive supportive care is needed to keep the animal hydrated from the severe fluid loss due to diarrhea.
- Antipyretics (Flunixin meglumine) may be useful for decreasing the animal's fever and assist in making the animal feel better so it will eat and drink.



MEDICATIONS

DRUGS OF CHOICE

- No medications are available for treating the disease other than fluids to keep the animal hydrated and antipyretics for fever control.

PRECAUTIONS

- Appropriate milk and meat withdrawal times must be followed for all compounds administered to food producing animals.



FOLLOW-UP

EXPECTED COURSE AND PROGNOSIS

- Depending on the strain of rinderpest virus, morbidity can be as greater than 90% and mortality can be very high (greater than 90%, particularly for European breeds of cattle, yak, and Asian water buffalo).

PREVENTION

- Virus is fairly fragile and is sensitive to heat and light. Decomposition of an infected carcass quickly kills the virus.

- Virus is primarily spread by direct contact with infected animals (oculonasal fluid and feces). Quarantine and the stopping of animal movement in infected areas can stop the spread of the disease to other susceptible herds.
- No carrier state has been observed in infected cattle that have recovered from the disease. However, some ruminants may shed the virus for a prolong time after infection.
- Vaccination of susceptible animals is a possible means of stopping the spread of the disease. Both modified live and killed vaccines have been prepared previously for use in some areas of the world and would probably be used in the event of an outbreak. Currently, no one is vaccinating livestock for this disease and vaccines are not available for distribution.
- Thorough cleaning and disinfection of an infected facility and allowing the facility to remain idle without animals present (usually 30 days) before repopulating the facility with new naïve animals is critical to prevent reinfection.



MISCELLANEOUS

ASSOCIATED CONDITIONS

- Sick animals become depressed, have diarrhea, become dehydrated and often die. These are the four “D’s” of rinderpest.

PREGNANCY

- Frequently animals abort.

BIOSECURITY

- Virus is primarily spread by direct contact with infected animals (oculonasal discharge and feces). Quarantine and the stopping of animal movement in infected areas can stop the spread of the disease to other herds. Fencing to prevent migration movement and mixing of numerous susceptible species is an effective method of slowing the spread of the disease.
- In an outbreak or in an endemic area, vaccination of susceptible animals is a possible means of stopping the spread of the disease. Both modified live and killed vaccines have been prepared previously for use in some areas of the world and would probably be used in the event of an outbreak. Currently, no one is vaccinating livestock for this disease and vaccines are not available for public distribution.
- Thorough cleaning and disinfection of an infected facility and allowing the facility to remain idle without animals present (usually 30 days) before repopulating the facility with new naïve animals is critical to prevent reinfection.

ABBREVIATIONS

- BT = Bluetongue
- BVD-MD = Bovine viral diarrhea-mucosal disease
- EHD = Epizootic hemorrhagic disease
- ELISA = enzyme linked immunosorbent assay
- FMD = Foot and mouth disease
- IBR = Infectious bovine rhinotracheitis
- PPR= Peste des petits ruminants

SEE ALSO

- Peste des Petits Ruminants
- Bluetongue Virus
- Epizootic Hemorrhagic Disease Virus
- Bovine Papular Stomatitis
- Bovine Viral Diarrhea Virus
- Orf (Contagious Ecthyma)
- Foot and Mouth Disease
- Infectious Bovine Rhinotracheitis
- Malignant Catarrhal Fever

Suggested Reading

Mukhopadhyay, A.,K., Taylor, W.P., Roeder, P.L., 1999. Rinderpest: a case study of animal health emergency management. *Rev Sci Tech* 18:164-178.

Roeder, P.L., Taylor W.P. 2002. Rinderpest. *Vet Clin North Am Food Anim Pract.* 18(3):515-47, ix.

Roeder, P.L. 2011. Rinderpest: The end of cattle plague. *Prevent Vet Med* 102:98-106.

Roeder, P.L. 2013. Rinderpest: Veterinary perspective on eradication. *Phil Trans R Soc B* 368:2012.0139.

Saliki, J.T., Wohlsein, P. 2008. Rinderpest. In, Foreign Animal Diseases, 7th Edition. Ed, Corrie Brown and Alfonso Torres. Committee on Foreign and Emerging diseases of the United States Animal Health Association. Boca Publishing Group, Boca Raton, FL, pp. 377-382. (ISBN 978-0-9659583-4-9).

World Organization for Animal Health. 2010. Rinderpest. In Atlas of Transboundary Diseases. Ed. Peter J. Fernandez and William R. White. World Organization for Animal Health, pp. 208-216 (ISBN: 978-92-9044-804-4).

Author Robert B. Moeller, Jr.

Consulting Editor Christopher Chase