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EPIZOOTIC BOVINE ABORTION

Epizootic bovine abortion has caused heavy calf losses—as high as 65% in initial pregnancies—in California beef herds since 1954. Affected cows show no signs of illness, but edema, hemorrhage, and liver damage are characteristic findings in the fetus. The cause of the disease is a large virus related to the psittacosis (parrot fever) virus. There are indications that an immunity develops in cattle which abort, but attempts to prevent the disease by vaccination have not been successful thus far. Antibiotic therapy is not a practical control measure. How the virus is maintained is not yet known. If it is proven to be venereally transmitted, artificial insemination may offer the only hope of bringing the disease under control.

FOR THE PAST eight or ten years epizootic bovine abortion (EBA) has caused extensive losses in breeding herds of beef cattle in California, but reports published as early as 1923 unmistakably described the same disease.

One of the reasons why this disease has recently assumed such importance is the great increase in cattle numbers in the State. Increased livestock traffic by improved transportation methods is another important factor in the spread of disease. Susceptible cattle are often brought into infected areas, or the disease can be spread to clean areas by the introduction of infected stock. Modern transportation stresses lower the resistance of animals to disease. Stresses also come from measures designed to increase production, such as the early breeding of heifers and the maintenance of cattle on high-level rations for extended periods. Several of the bacterial diseases that produced widespread abortion in previous years have been brought under control, with the result that EBA has assumed relatively greater importance. It was not until about 1956 that the clinical and epidemiological features of EBA became well recognized.

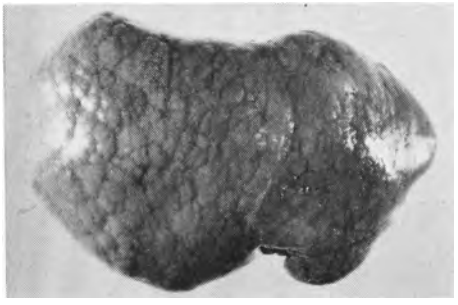
Clinical symptoms

EBA now occurs in beef cattle, although studies conducted in the early 1950's indicated that it was then a disease of dairy herds. Its incidence is high in first-calf heifers, or in herds in which the infection has not occurred previously. The abortion rate frequently reaches 65%. It drops markedly in subsequent years, except in heifers in their initial pregnancies. The abortions occur during the last trimester of gestation, usually between the sixth and eighth months. Calves which occasionally are born at, or near, term are usually alive at birth. Generally, however, they are weak and survive for only a short time. No signs of illness associated with the abortion syndrome are observed in affected cows.

Pathological findings

In aborted fetuses, a reddening of the skin is evident, particularly in the area of the groin. Generalized edema is also a common finding and is frequently so extensive as to cause distension of the abdomen. Hemorrhages are noted on the tongue and on the inner surface of the eyelids, and in most subcutaneous areas of the body. Hemorrhages may be present also in the trachea. On opening the fetus the most striking finding is the large amount of straw-colored fluid in the abdominal cavity, and the enlarged liver. The liver is sometimes a reddish orange in color and is frequently lobulated. Histopathological studies reveal extensive damage associated with the blood vessels, particularly those of the brain. In only a small proportion of aborted fetuses will more than one of these gross signs of infection be apparent.

Enlarged nodular liver from an aborted fetus depicts the changes which occur in this organ due to epizootic bovine abortion infection.



Fetus pictured above was aborted in an outbreak of epizootic bovine abortion. Note the generalized edema and distension of the abdomen due to an excessive amount of peritoneal fluid.

Epidemiology

The epidemiology of EBA is not understood. The high prevalence of the disease in beef cattle, as compared with dairy cows, is attributed by some to the possibility that pregnant cattle become infected while on foothill pastures. It is believed that the causative agent of the disease is harbored in some wild animal or bird which inhabits foothill areas, and is transmitted to susceptible cattle by ticks or insects. Because of this association, the disease has become known as "foothill abortion." Other investigators feel that the alleged association between abortion and pasturing in foothill areas is strictly coincidental, since most, if not all, beef cattle in California spend at least part of the gestation period in foothill and mountainous areas. However, isolation of the causative virus should aid greatly in resolving this very debatable and extremely important question.

Etiological studies

In 1959, a virus was isolated from a number of aborted fetuses in which changes characteristic of EBA infection were present. This virus was found capable of causing abortion in cows, and the same changes were found in the aborted fetuses as in fetuses from field outbreaks

of the disease. The abortions could be produced from two weeks to four months after inoculation, depending on the amount of virus given and the route by which it was inoculated. Following inoculation, cows developed a high fever lasting for several days, but they did not display any visible signs of illness, following either inoculation or subsequent abortion. On the basis of these findings, which correlated closely with observations made of the disease in the field, it was concluded that the causative agent had been isolated.

EBA virus characteristics

The virus causing EBA is a member of a large group of agents, known as the Psittacosis-LGV group, which is responsible for several distinct diseases including psittacosis of birds and man, venereal disease of man, encephalitis of cattle, diarrhea of calves, abortion of sheep, and mild respiratory disease in cats and laboratory mice. Most of these viruses are relatively host-specific in that they cause disease only in the one species of host. They are so large that, like bacteria, they can be observed by means of the ordinary light microscope. Also, like bacteria, they are sensitive to some of the common antibiotics.

Another characteristic of the group is that all or most members share a common component known as an antigen. This antigen governs immunity produced by these viruses and also their serological behavior. However, this antigen makes it very difficult, if not impossible, to differentiate accurately between different members of the group. This is a problem that must be resolved before it will be possible to conduct meaningful epidemiological studies of the disease. Fortunately, this common antigen provides a possible method of immunization whereby infection with one member of the Psittacosis-LGV group may be prevented by use of a vaccine prepared from another virus belonging to the same group.

The heavy losses incurred by EBA made it mandatory, when the causative agent was isolated, that immediate steps be taken to bring the infection under control. Two approaches to the problem were available—antibiotic treatment and immunization.

While the EBA virus is sensitive to certain antibiotics, the cost of treating such large animals as cattle with these compounds makes their use almost prohibitive. The fact that treatment would be necessary while the cattle were on summer pastures presents another problem. However, a feeding trial was undertaken, using an antibiotic in the form of a feed additive, but many disadvantages of this method of treatment soon became apparent. For these reasons, treatment as a possible means of controling the infection was abandoned.

It was also realized that, in general, the immunity resulting from infection with members of the Psittacosis-LGV group of viruses is not particularly durable. This lack of durability, and the fact that antibiotic treatment is usually successful, has curtailed immunization against these infections. However, since sheep can be immunized against abortion caused by one of the Psittacosis-LGV group of viruses, and inasmuch as immunity appeared to develop in cattle following abortion, indications were that vaccination might prove to be successful in preventing the disease.

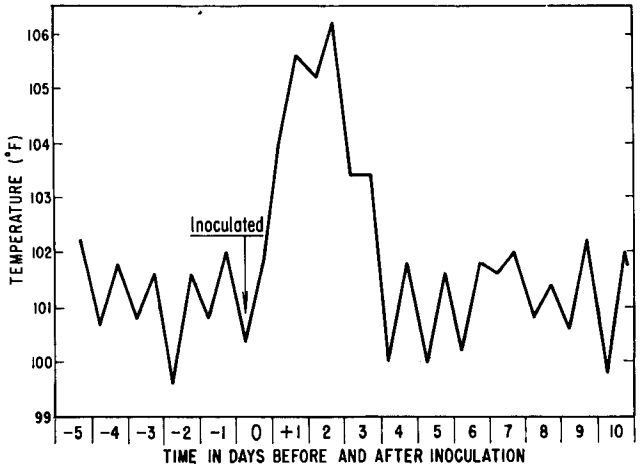
Two unsuccessful trials have been conducted thus far with a vaccine consisting of EBA virus treated with formalin to render it inactive or inert. The finding that little or no protection was conferred, tended to confirm theories that the use of a living, or viable, virus vaccine would be needed to produce any degree of immunity to the EBA virus.

While the live EBA virus does not cause illness in cattle, its use in vaccinating cows before pregnancy was considered inadvisable, because of the lack of knowledge of how the virus is spread. If it is found to be transmitted by ticks or insects, there would be great danger that the inoculated cattle would provide a source of infection for pregnant cows.

Some viruses can be weakened without affecting their capacity to immunize, so that they no longer are capable of causing disease. This process is known as "modification" or "attenuation." It is a time-consuming procedure, which involves growing the virus in successive passages in alien hosts, such as chicken embryos, mice, or tissue cultures. Efforts to attenuate the EBA virus in this manner have been underway for some time. It is hoped that the virus can be weakened for eventual use as a viable immunizing agent without danger of producing abortions.

Anticipating that it might not be possible to attenuate this virus, another virus of the Psittacosis-LGV group—which causes a mild respiratory infection (pneumonitis) in cats—is being tested. This virus might be capable of immunizing cattle against abortion by virtue of the common antigenic component shared by all or most viruses of the Psittacosis-LGV group. The cat virus was selected because of the mildness of the disease which it produces in the natural host, and because tests showed that it did not cause cattle to abort. At present, this vaccine is undergoing field testing in several herds in the State.

Characteristic temperature response of cattle to inoculation with virus of epizootic bovine abortion.



Natural immunity

Recent studies suggest that the immunity which develops in EBA differs from that associated with recovery from most virus diseases. It appears possible that venereal infection occurs at the time of natural service and that the virus becomes established in the uterus. The immunity developed by the body during the initial pregnancy apparently is insufficient to prevent the virus from causing abortion However, by the time of the second pregnancy, the body has developed sufficient immunity to curtail the disease-producing activities of the virus. At the same time, the presence of the virus in the uterus prevents the establishment of virulent EBA virus, to which cattle might be exposed subsequently and which would be

fully capable of causing abortion. This type of immunity is known as "infection immunity," and it operates in some diseases caused by the Psittacosis-LGV group, psittacosis being an example. However, it is an unstable type of immunity since stresses which lower the resistance of the body enable the virus to resume its disease-producing activities.

Should this be the type of immunity associated with EBA, vaccination with an inactivated virus would be futile since the virus, being inert, could not multiply and localize in the uterus. However, if a living but weakened EBA virus could be established in the uterus by vaccination before field exposure to virulent virus, it is possible that abortions could be prevented. Such a delicately balanced mechanism might provide a very unreliable and unsatisfactory immunity, however, so additional means of control of EBA must be considered.

As mentioned previously in this report, EBA was once believed to occur widely in dairy herds in California, but since about 1955, it has occurred almost exclusively in beef cattle. One possible explanation for the disappearance of the disease from dairy herds is that artificial insemination was first introduced on a large scale at about that time. This measure greatly reduces the incidence of venereally-transmitted diseases. Infectious infertility of cattle, a disease spread by breeding operations, has been practically eradicated in South Africa by means of artificial insemination. While it has yet to be proved that EBA is a venereally-transmitted disease, this possibility must be taken into account in any long-range planning for its prevention and control. Efforts to develop a satisfactory method of immunization against this disease will be continued, but artificial insemination may be the final resort in bringing the disease under control.

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New Alfalfa Variety Resists Spotted Aphids and Produces High Yields

SONORA

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Since 1954, the spotted alfalfa aphid has severely damaged alfalfa in California, Arizona, and Nevada. Plant breeders and entomologists from all three states have worked to develop Sonora—a new variety, resistant to the aphid and high producing, particularly in winter and early spring. The purple-flowered, upright-growing Sonora recovers rapidly after cutting and is adapted to areas of the Southwest, formerly planted to African, where winter forage production is desired.

Testing plants for resistance to the spotted alfalfa aphid. A single alfalfa stem was placed in each cage and infested with aphids. Only plants on which growth and reproduction of spotted alfalfa aphids were severely reduced or stopped were used as parents of Sonora.