

Vaccinations to Optimize Reproductive Efficiency

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Introduction

Do current vaccines aid in reproductive performance? Can we establish a vaccination program that can help prevent reproductive loss from diseases? During gestation, the bovine reproductive system, with its multi-layered placenta, leaves the fetus in a naive environment susceptible to infection. Abortions may occur due to infection of the placenta, inflammation of the ovary, death of the fetus and/or disruption of the cervical plug. Thus, reproductive disease is the hardest to protect against. Vaccination must minimize the amount/duration of the viremia/septicemia or prevent disease from moving through the cervix.

Research is under way on reproductive diseases and vaccine development. Current research is aimed at establishing a vaccination program to control reproductive diseases. Unfortunately, there is little or no research regarding the reproductive efficacy of many vaccines currently used to prevent reproductive disease. Due to the numerous causes of reproductive failures (of which infectious agents are a small percentage), vaccinations to prevent infectious reproductive losses many not appear to be effective. This is often due to the fact that diagnostic testing has not been attempted or has not determined the cause of reproductive inefficiencies. A vaccination program may be inappropriately instituted when the cause is not infectious, or the current program may be unfairly deemed ineffective.

Since there are many infectious and non-infectious causes of bovine reproductive failure, only diseases for which there are licensed United States Department of Agriculture vaccines will be discussed.

Overview of Reproductive Diseases

Bovine Virus Diarrhea Virus

The control of bovine virus diarrhea virus (BVDV) centers on prevention and elimination of persistently infected cattle. The identification and removal of persistently infected animals and continued vaccination to prevent persistently infected animals are necessary for effective control measures. Persistent infections occur following in utero infection of the fetus (up to approxi-

mately 125 days of gestation) with a non-cytopathic strain of BVDV. The mechanism of transplacental transfer of BVDV is unknown. However, small amounts of virus in the bloodstream of the dam appear sufficient to cause development of these immunotolerant cattle. Protection of the dam may or may not correlate with protection of the fetus from subsequent persistent infection if viremia occurs in the dam. In order to break the vicious cycle of in-utero infection and persistent infection, it is essential that vaccination provide fetal protection. BVD strains also can cause early embryonic deaths, early to mid-term abortions, weak, ruttled calves and/or persistently infected calves.

Several studies have assessed the ability of vaccines to protect the fetus against either a natural or artificial challenge. The majority of inactivated vaccines failed to provide much fetal protection except for 1 experimental vaccine, which is reported to give a high level of fetal protection. With this experimental vaccine, the lack of virus isolation from offspring of vaccinated animals indicated good protection. However, the challenge of controls only resulted in approximately a 50% rate of persistent infections. Other reports have demonstrated that modified live BVDV vaccines were more effective at protecting the fetus. To date, vaccines licensed in the United States have not been required to provide fetal protection.

Bovine Herpesvirus Type-1

IBR (infectious bovine rhinotracheitis, rednose) can spread easily through respiratory, ocular and reproductive secretions from infected cattle. The virus remains in post-infected animals via latent infections of the trigeminal ganglia. Infections with BHV-1 cause severe respiratory tract infections with a 5-10% death loss. Field exposure to BHV-1 can cause up to 25% of the cows to abort. While the majority of BHV-1 abortions are seen in the last trimester of pregnancy, abortions can occur at any stage. Expulsion of the fetus may be delayed up to 100 days after exposure to the virus. Vaccination with a modified live BHV-1 vaccine or natural exposure to the virus can cause temporary infertility due to follicular necrosis in BHV-1 seronegative cows. The decreased conception rate for the heat cycle following this occur-

rence has been estimated to be 30%. The effect on the ovary has not been seen in seropositive heifers.

This virus also can cause conception failure as a venereal disease (infectious pustular vulvovaginitis). Pustular and necrotic lesions are seen on the vulva and vaginal tract and a balanoposthitis can be seen in bulls. A mucopurulent discharge may be seen during the infection in cows. The disease is spread primarily by infected breeding bulls and occasionally by the sniffing habits of cattle.

There are few published reports of BHV-1 vaccines' ability to protect against abortions and protection has been shown only with modified live BHV-1 vaccines.

Brucella abortus

Brucella vaccines have been the most effective in controlling a reproductive disease. The successful control and eradication of *Brucella abortus* from many areas in North America is testament that a program involving testing, culling and vaccination can control a reproductive disease.

Abortions due to *Brucella abortus* are seen usually after five months of gestation. Retained placentas and subsequent metritis usually follow. Abortion is caused by severe placentitis. *Brucella* infections also have been associated with decreased conception rates and increased services per conception. Increased numbers of dead and weak calves also have been demonstrated in infected herds. Orchiditis and/or seminal vesiculitis may characterize infections in bulls.

Vaccination with either strain 19 or RB51 *Brucella* have been shown to be effective. Recently, many herd managers have stopped vaccinating against this disease as most states have been declared Brucellosis-free.

Leptospira interrogans

Leptospira can cause severe liver and/or kidney disease, and in some situations causes mastitis. Many different serovars of *L. interrogans* have been shown to cause reproductive failure and abortions in cattle. *L. interrogans* serovar *hardjo* is the cattle-maintained serovar and accounts for the majority of cattle infections. *L. interrogans* serovar *pomona* is maintained in pigs and other mammals and is the most common incidental *Leptospira* diagnosed in cattle.

These bacteria can cause abortion storms in which high numbers of cattle abort within a short period of time. There may be increased stillbirths, premature and weak calves. While serovar *pomona* tends to cause abortions in the last trimester, serovar *hardjo* can cause abortions at any stage of pregnancy. Abortions usually are due to fetal infections and subsequent death of the fetus. Serovar *hardjo* can also colonize the oviducts, decreasing fertility. After an initial *Leptospira* infection, cattle may remain infected and shed the spirochete for

long periods of time. *Leptospira* vaccinations (initial and booster) help prepare a heifer for entry into the breeding herd. There have been many debates about the ability of *Leptospira* vaccines to prevent abortions. This apparent lack of efficacy may be due to the antigenic difference between serovar *hardjo* types *hardjo-ovis* and *hardjo-pratjino*. However, infertility problems have been shown to decrease in herds after vaccination.

Bovine Genital Campylobacteriosis

Originally classified as *Vibrio*, *Campylobacter fetus* subspecies *venerealis* causes a venereal infection of cattle. The bacteria are introduced during natural breeding by infected bulls or by artificial insemination using infected semen. Bulls are usually infected by servicing infected cows, but contact with infected bedding may also cause infection. Older bulls (>4 years of age) are more likely to be infected. After being deposited in the vagina, the bacteria rapidly colonize the vagina and cervix. In 25% of cows bacteria will be found in the oviducts. It can persist for months after infection at these sites.

Early embryonic death and prolonged estrus cycles are the most common signs in *Campylobacter*-infected cows. Early abortions also may be seen. The signs are much higher in heifers, with immunity developing after a 4 to 6-month cycle with the infection. It has been shown that fertility never returns to normal in some infected animals. Some animals may be permanently sterile due to damage after salpingitis.

Vaccination for *Campylobacter* has been shown to be effective in protecting heifers even when vaginal cultures are positive for the bacteria. This is believed to be due to the fact that the uterus is very resistant to the bacteria after vaccination. Studies also have demonstrated improved breeding efficiency in vaccinated herds. Furthermore, vaccination with 2X dose and/or two doses has been shown to be effective in clearing infections from carrier bulls.

Bovine Trichomoniasis

Bovine Trichomoniasis is a venereal infection of cattle caused by the protozoal agent *Tritrichomonas fetus*. Early in an infection, abortions with pyometra may be seen in 5% of the pregnant cattle. These abortions occur early in gestation. However, infertility is the most common sign with long interservice intervals. Early embryonic death is followed by a period of conception failure. There is some natural resistance after infection, but carrier cows may be an important component of the epidemiology of this disease. It is rare, but a cow may become sterile following an infection due to uterine destruction.

Efficacy of *Tritrichomonas* vaccines is questionable and estimated to be at best 60%.

Hemophilus somnus

The effect of *Hemophilus somnus* on the reproductive tract is unclear. *Hemophilus somnus* has been associated with early embryonic deaths, abortions and conception failure. However, the bacteria is a normal inhabitant of the vaginal tract and can be cultured from both bred animals as well as animals that have aborted. Whether *H. somnus* truly causes reproductive disease or only sporadic uterine infections is a source of debate. Recent textbooks only list *H. somnus* as a potential finding in uterine cultures.

There is no evidence that *H. somnus* vaccines impact reproductive efficiency. The current vaccines are licensed on their effectiveness at stopping the thromboembolic meningoencephalitis syndrome.

Vaccination Programs

Vaccination programs in the herd need to be custom-designed for the particular needs of the herd. Vaccination programs in replacement stock have 2 specific goals that need to be considered. The first is to prepare the calf against pathogens that are causing disease problems. The second is to prepare the calf for entry into the adult herd with a good foundation of protection from which to build herd immunity. Immunization of the replacement heifer can have a dramatic impact on the health of the adult herd. In order to control reproductive diseases and improve reproductive efficiency, a program that entails both an effective vaccination program and management is mandatory.