Immunization Programs for Cattle

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Introduction

Infectious disease control through vaccination is an important component of bovine herd health but it is only a part of the total program. Vaccination reduces the probability of catastrophic losses but should not be expected to prevent all losses.

The benefits of vaccination are difficult to evaluate and unlike insurance, vaccination provides no compensation when losses occur. Thus, many livestock owners resent the continuous commitment of resources needed for herd immunity because they see few visible returns on investment.

The subtle effects of inapparent infectious diseases probably result in as much economic loss as clinically-manifested disease outbreaks. However, these occur sporadically and are not recognized readily. Thus they lack the impact needed to stimulate preventive action. On the other hand, herd outbreaks accompanied by serious losses from infectious diseases often provide the inspiration to invoke vaccination programs. Under these conditions, the urgent need to "do something" can result in neglecting consideration of managerial errors provoking the episode and irrational use of vaccines can occur.

Not infrequently, fragmentary information suggests answers to persistent problems and there is a temptation for veterinarians and livestock owners to conspire against their own best interests by sanctioning use of vaccination procedures of unproved effectiveness because premature vaccine availability has a repressive effect on further research.

The basic elements of vaccine-centered cattle disease control programs are: 1) common sense, 2) skilled evaluation of potential losses in each specific production/management system, 3) understanding of the pathogenesis of bovine infectious diseases, and 4) knowledge of indications and potential hazards of available vaccination regimes.

Whatever approach is utilized, efforts should be made to maximize vaccine protection, minimize vaccine risks, adhere to the manufacturer's recommendations, and maintain high ethical standards.

The objectives of vaccination programs are to generate herd resistance so death, sickness, abortion, and neonatal mortality are minimized while promulgating a disease prevention philosophy emphasizing vaccinating healthy cattle for long-range benefits.

Vaccination programs for individual herds depend on their management practices and production objectives. This requires mental organization of available knowledge.

The "facts" associated with bovine vaccines are controversial and altered by frequent emergence of new information. The legitimate disagreements existing among researchers from industry, government, and academia indicate more knowledge and improved technology are needed in the areas of: 1) clinical diagnosis of bovine diseases, 2) duration of immunity and frequency of vaccination, 3) vaccination in the presence of infections or stress, and 4) vaccination of pregnant cattle.

Current concepts in these areas must be discussed as a preface to specific recommendations.

Current Concepts

Concept: Inadequacy of Clinical Signs for Diagnosis of Bovine Viral Diseases

Clinical diagnosis of bovine viral disease is difficult and confusing. For example, the clinical signs associated with many bovine respiratory infections are similar. The cautious diagnostician is aware that few signs or gross lesions are pathognomonic and acknowledges ignorance by using the term "undifferentiated respiratory disease." There are many etiologic agents (frequently occurring in combination) which cause fever, anorexia, increased respiratory rate, and excessive nasal discharge. These can include infectious bovine rhinotracheitis (IBR), bovine myxovirus parainfluenza-3 (PI3), bovine viral diarrhea (BVD), and numerous other ubiquitous viruses and bacteria. The etiologic clues available clinically are discoverable only with careful examination of the oral mucosa (for ulcers, erosions, necrosis, or vesicles) and careful examination of the nasal septae for necrotic plaques characteristic of IBR. These examinations must be coupled with careful auscultation of the lungs and trachea to ascertain presence or absence of obstruction of the upper or lower airways.

Even with serologic and virologic testing, the role of primary specific etiologic agents, stress, environment, and secondary bacterial infection cannot be unraveled in most cases (3).

Concept: Nature and Duration of Immunity

If we grant that resistance to clinical manifestations upon exposure is subject to extreme individual variation, and that there is probably no such thing as "solid immunity," then the relationship

between previous viral infection (with field strains or modified live-virus (MLV) vaccines) and protection can be oversimplified as follows. Assuming that nonclinical infection with vaccine virus is the measure of successful vaccination and leaves vaccinated cattle with a "partial protection," then successful vaccination prior to pregnancy should protect against abortion from IBR (8) and BVD. Successful vaccination prior to exposure should prevent clinical BVD (7,10) and should prevent severe systemic manifestations from exogenous exposure to IBR (3). With IBR, successful vaccination will not assure that subsequent exposures will not result in infection of mucosal surfaces or establishment of latent infection which can occur in both vaccinal and field strains of virus. However, previous successful vaccination should engender enough resistance (through local resistance factors, humoral antibody, or anamestic immune response) that the animal survives the exposure unless serious complications occur (3). The duration of this "partial protection" against subsequent exposure to IBR and BVD is debatable (2) and leaves the question of revaccination contingent on the age at first vaccination, the purpose for which the cattle are kept, the importance attributed to infections of partially protected cattle in the specific environment under consideration, and on the faith of the decision-maker in the concept of "herd immunity."

In the case of PI3 and other ubiquitous viruses of uncertain pathogenicity, both the solidarity and duration of the partial protection engendered by primary infection are subject to question. The questionable pathogenicity of singular infection with PI3 (1,5) makes PI3 vaccine use most rational when incorporated with IBR vaccine used after careful consideration of the IBR situation.

Concept: Vaccination in the Presence of Infection or Stress

Vaccines are intended for use on healthy animals prior to exposure. Vaccination after onset of disease promulgates the philosophy that vaccines are curative and that control procedures can be postponed until disease appears.

The difficulty in clinical diagnosis of bovine viral diseases (2) provides considerable uncertainty about which vaccine to choose when deciding if vaccination of sick animals or their herdmates is indicated.

Live vaccines and the restraint required for their administration can be inducers of stress. Stress is a recognized component of epizootics of bovine respiratory disease and the value of adding further stressors to outbreak situations must be seriously questioned. Even the most avirulent vaccines occasionally cause reactions (4) and post-vaccination reactions to both IBR and BVD vaccines are frequently of multifactorial etiology (6).

Natural disease occurring after administration of vaccines to incubating cases can be erroneously attributed to vaccine. This "black eye" on vaccines serves as a psychological deterrent to later use of healthy, vigorous animals and thus hampers disease control efforts.

Abortion following vaccination of pregnant animals in the "face of an outbreak" is usually blamed on vaccine when in many cases it is due to natural infection.

Vaccination administered during outbreaks is usually a one-time procedure performed when it is too late. Following vaccination under these circumstances, disease control is usually forgotten and the fact that repopulation with susceptible cattle is a continuous process is ignored. Careful evaluation of diagnostic, environmental, and temporal considerations and knowledge of favorable or unfavorable sequela of vaccines usually indicate a conservative approach to use of vaccines during outbreaks. The presence of pregnant cattle in affected populations narrows vaccine choices to inactivated or intranasal products or others declared safe for pregnant cattle. Even lacking pregnant cattle, inactivated or intranasal vaccines are probably the best candidates for use when clinical judgments suggest violation of the basic axiom of keeping vaccines away from sick cattle. In any case, the possible effects of the stress and strain of handling sick and exposed cattle must be added to the cost of vaccination in attempting to estimate comparative costs of vaccinate/not vaccinate decisions.

Recommendations

Using the concepts developed above, vaccination recommendations for various farm conditions can be presented. They must be modified for each local situation and adjusted as new information appears.

Self-Contained Dairy Herds Which Raise All Replacements

The major objective of a vaccination program for self-contained dairy herds is to assure that the herd has enough cattle with partial protection against IBR, BVD, and PI3 to accomplish reduction of abortions and other viral-induced fetal wastage. This goal can be accomplished by vaccinating all calves for IBR, BVD, and PI3 sometime after six months of age, but this author does not recommend vaccination within one month of anticipated breeding date nor anytime after the first breeding. This is a calfhood vaccination program and does not involve vaccination of adult cattle. The emphasis on preventing fetal wastage by protecting brood cattle from infections during pregnancy indicates vaccination can be postponed until 10 to 13 months of age, but should be administered well before breeding. Revaccinations can be conducted if a suitable time in the management scheme can be identified and if the clinician feels it is necessary. However, if 100% of calves are vaccinated, adequate herd immunity should persist such that minimal benefit will be derived from revaccinations and the required resources can probably be better utilized elsewhere.

Herds Which Purchase Pregnant Replacements or Fresh Cows

This is an almost impossible situation for disease control programs because of the multiple management-related health problems which occur. Probably the most underestimated of these is the psychological stress of immigration and constantly changing peck-orders. From a virologic point of view, continual introduction of new viral infections probably provides a degree of herd immunity adequate to prevent catastrophic losses from the common ubiquitous bovine viruses (but not pulmonic pasteurellosis). However, this haphazard, unplanned infection cannot be counted on to constitute a "natural vaccination program."

The veterinarian should inform the owner that this type of management involves tremendous hazard from a disease standpoint and discuss this risk in light of the alternative of raising replacements or establishing enough control over replacement sources that calfhood vaccination is assured.

If the owner insists on vaccination of adult or pregnant dairy cattle, use the avirulent intranasal or inactivated vaccines. Avoid use of BVD vaccines in these herds. They usually have high antibody prevalence anyway and the vaccination of new arrivals is probably contraindicated because the stress of movement and socialization probably causes endogenous steroid outpouring and could probably mimic the effects of administration of corticosteroids. The resulting immunosuppression could be adequate for pushing an otherwise non-clinical vaccine virus infection into a clinical disease state (10).

Cow-Calf Operations

The object of this program is to maintain herd immunity in the breeding animals and, if possible, vaccinate the calf crop prior to sale and passage through collection points bound for backgrounding or feed yards. The possible premium price for calves so treated must exceed the cost of vaccination. If feasible, and potentially profitable, beef calves should be rounded up and vaccinated before weaning and castration. This may not be possible or economically feasible and if done, vaccines contraindicated for nursing calves must be avoided.

In any case, heifers being kept for breeding should be vaccinated with IBR, BVD, and PI3 after six months of age and well prior to breeding.

Veal Growers and Other Operations Assembling Neonatal Calves

These operations assemble three- to seven-day-old calves, many of which have not had colostrum. In the first 14 weeks they suffer considerable mortality from stress-induced syndromes associated with colibacillosis, salmonellosis, and pasteurellosis. Any vaccination procedure must be carefully thought out, particularly if MLV vaccines are under consideration. Because they should be administered at birth, the reovirus and coronavirus vaccines should not be expected to markedly alter mortality patterns in these operations.

It is my judgment that MLV vaccines are not indicated in these circumstances except under unusual conditions. A wide variety of bacterins and vaccines have been used in neonatal calf assembly operations with very little success. Most scholars agree the lack of colostrum, the stress of assembly, and unnatural dietary and housing conditions combine with build-up of microbiologic flora to produce disastrous situations which are not amenable to control by vaccination.

Calves that survive until six months of age should then be vaccinated as described above, depending on their ultimate destination.

Feedlots

A substantial part of the above rationale involves preventing abortions and fetal wastage. This is not a consideration in feedlots, but respiratory infections are. If possible, IBR, BVD, and PI3 vaccinations should be done prior to movement to assembly points, backgrounding areas, or feed yards. For economic reasons, this is usually not done and cattle of unknown vaccination and exposure status arrive in feed yards.

Most operators initiate various vaccinations upon entry, concomitant with the upset of movement, reassembly, and dietary adjustment. Data can be found to support almost any program suggestable, but the fact is, a totally satisfactory solution to the dilemma of feed-yard respiratory diseases has not evolved (1). Feedlot vaccination practices are based on clinical impressions and subject to considerable controversy. I would advise administration of intranasal vaccine for IBR and PI3 immediately upon arrival and recommend avoiding use of the live BVD vaccines in feed-yard situations.

Exhibited Cattle

Cattle moving to shows and fairs must meet specific state and local requirements. The veterinarian must consider the health of the exhibited cattle, the health of other cattle at the show, and the hazard of herd exposure upon return. If I were showing cattle, I would administer a combination IBR and PI3 vaccine (9) to *all* cattle and BVD vaccine to non-pregnant cattle at least 90 days prior to departure. Because of the legal implications, the difficulty in enforcement and possible effects on subsequent value for export (particularly of bulls), this procedure should be a recommendation and not a requirement. Its feasibility should be examined on an individual, herd, and area basis.

Artificial Insemination Units

Vaccination programs for artificial insemination units present unique problems. The concern for the health of the bulls is important but this consideration is sometimes overwhelmed by export requirements for sero-negative semen donors.

Designing vaccination programs should involve antibody prevalence studies for IBR and careful evaluation of potential risks of attempting to maintain an IBR-free stud (3).

Conclusion

Healthy, well-nourished calves vaccinated prior to breeding for IBR, BVD, and PI3 will have reduced probability of aborting or suffering severe disease due to these viruses.

Vaccination in the presence of exposure, disease, or during adjustment to new feed or a new environment is risky and should be approached conservatively.

The veterinarian should accept the responsibility to invoke available vaccinations in a manner most suited to each management situation so as to provide the maximum protection to the most animals while taking the least risk.

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