1975

Immunity to Neonatal Calf Diarrhea

James A. Roth  
*Iowa State University*

J. W. Sexton  
*Iowa State University*

Follow this and additional works at: [http://lib.dr.iastate.edu/iowastate_veterinarian](http://lib.dr.iastate.edu/iowastate_veterinarian)

Part of the [Large or Food Animal and Equine Medicine Commons](http://lib.dr.iastate.edu/iowastate_veterinarian)

**Recommended Citation**  
Available at: [http://lib.dr.iastate.edu/iowastate_veterinarian/vol37/iss1/10](http://lib.dr.iastate.edu/iowastate_veterinarian/vol37/iss1/10)

This Article is brought to you for free and open access by the Student Publications at Iowa State University Digital Repository. It has been accepted for inclusion in Iowa State University Veterinarian by an authorized editor of Iowa State University Digital Repository. For more information, please contact digirep@iastate.edu.
Immunity to Neonatal Calf Diarrhea

by

James A. Roth *
J. W. Sexton D.V.M., M.S.†

At the 1973 American Association of Bovine Practitioners (AABP) meeting, Dr. Paul Blackmer of Ontario, California reported on an interesting survey which he had run in his dairy practice. On dairy or calf ranches experiencing a mortality problem, he collected serum samples from calves 24–48 hours old. Then he ran the sodium sulfite turbidity test on these samples. By this test calves were grouped into three groups based on visual turbidity. Then after three to four weeks he correlated the morbidity and mortality data with the sodium sulfite test results. The correlation was usually very good. Calves whose serum had the greatest turbidity in the sodium sulfite test (normogammaglobulinemic) had a less than 10% mortality, whereas calves with the least turbidity (hypogammaglobulinemic) experienced a 30–50% mortality.2 Other experiments and farm surveys also substantiate his findings that the morbidity and mortality chances of a calf can be predicted by the time the calf is 48 hours old by determining the serum immunoglobin level.3,4,13

In one study newborn calves with IgG and IgM levels of less than 0.8 and 0.2 mg./ml., respectively, died of neonatal septicemia, whereas calves with IgG and IgM levels of 5.0 and 0.6 mg./ml., respectively, developed enteric infections. Calves with postcolostral serum levels of 7.5 and 0.8 mg./ml. of IgG and IgM, respectively, were normal.8 Thus calves with moderately low levels of immunoglobins had enough immunity to prevent septicemia but didn't have enough to prevent enteritis.

There are several tests to determine the serum immunoglobin levels of a calf. Electrophoresis and immunodiffusion are the most sensitive methods for determining gamma globulin, but they are too time consuming and costly to be of practice value in a calf-testing program for an average dairy.13

The sodium sulfite test referred to above is the simplest procedure to use. A 36 per cent (weight per volume basis) solution of Na2SO3 · 7H2O is prepared. Add 19 drops of the sodium sulfite solution to one drop of calf serum in a test tube; invert the tube two or three times to facilitate mixing. A precipitate will form almost immediately. This will vary from a slight cloudiness to a copious precipitate.12 This precipitate consists primarily of immunoglobins. There is also a zinc sulphate turbidity test which requires a colorimeter and is better standardized than the sodium sulfite turbidity test.

The bovine placenta is incapable of transporting maternal immunoglobins to the fetal circulation; therefore, the fetal calf remains essentially agammaglobulinemic during fetal life and requires ingestion of colostrum within the first 24 hours of life to receive passive resistance. Bovine colostrum contains high levels of im-

* Mr. Roth is a fourth year student in the College of Veterinary Medicine at Iowa State University.
† Dr. Sexton is an Assistant Professor of Veterinary Clinical Sciences at Iowa State University.

Iowa State University Veterinarian
munoglobins. Approximately 75% of this is accounted for by IgG; IgM and IgA jointly account for approximately 20% of the immunoglobins in colostrum. In the neonate the intestinal absorption of colostr al antibody is not selective, thus the immunoglobin profile of postcolostral calf serum resembles that of colostrum. This provides the unusual occurrence of high levels of secretory IgA in blood circulation. Secretary IgA and IgM make a significant contribution to passive immunity, although their half-lives in calf serum are only two and four days respectively.9

In a recent study it was shown that the synovia of neonatal calves was agammaglobulinemic. Within two hours after these calves were fed colostrum, globulins appeared in the serum and, within four to eight hours in the synovia. The immunoglobulin profile of the synovia resembled that of the calf's and the dam's sera.11 This helps to explain why calves which receive colostrum are more resistant to septicemia and polyarthritis than calves which are colostrum deficient.

Immunoglobulin concentration in bovine milk falls rapidly to low levels during the first three days of lactation and is unlikely to contribute much to local alimentary tract defense after the first week. However, local synthesis of immunoglobins is demonstrable in immunocytes situated close to the epithelium of the alimentary tract and local secretion of immunoglobins commences in the second week of life.8

Milk secreted by monogastric species continuously contains a fairly high level of IgA. The low concentrations of IgA and other immunoglobins secreted in the milk of the ruminant after the first three days may be related to the need for development of rumen function in the young.9

The efficiency of antibody absorption decreases rapidly from the time of parturition so that in one investigation dairy calves which failed to suck during the first eight hours of life were invariably immune globulin deficient. The generally low levels of serum immune globulin in calves on farms where colostrum is bucket fed have been attributed to feeding too little too late.8

Higher immune globulin levels have been found in dairy calves kept with their dams for the first 24 hours of life than in calves which were put with their dams only at feeding times. As both groups of calves were permitted to suck at the same fixed times and consumed similar amounts of colostrum, it appeared that calves isolated from their dams could have impaired immune globulin absorption due to maternal deprivation.

Thus the available evidence indicates that to achieve high serum immune globulin levels, calves should be left with their dams for the first day of life to permit sucking by the calf and to facilitate efficient globulin absorption.

A number of reports during the last 15 years indicate that the fetal calf is capable of producing antibodies to a variety of infectious agents, including *Leptospira saxkoebing*, *Anaplasma marginale*, parainfluenza-3 virus, *BVD* virus, *Vibrio fetus*, *Chlamydia*, bluetongue virus, *Brucella abortus*, *Salmonella dublin* and *E. coli*.8

There are two factors that suppress the active immunity of a calf at birth. One factor is the high glucocorticoid level in the newborn calf. Evaluation of plasma corticoid values indicated that levels two to five times the prepartum fetal or adult values were present in the plasma of calves at birth. Corticoids are known to have immunosuppressive effects and possibly cause a decline in cellular immunity at this time. This observation may be of considerable significance in neonatal infection since the elevated plasma corticoid levels may suppress the function of this extremely important limb of the immune response.8

The second factor that suppresses the immune response of the newborn calf is the passively acquired antibodies from the colostrum. Thus an immunological paradox occurs in the newborn calf. Colostrum is of paramount importance in protecting the calf from microbial infection, but passively transferred antibodies also interfere with the initiation of the calf's active immune response to specific antigens.

The antigen, instead of being presented to the appropriate cells for immunization,
interacts with circulating antibodies and then is removed from circulation presumably by the reticuloendothelial system. Exceptions may occur, particularly if antigen antibody complexes form in antigen excess. These circumstances initiate an accelerated immune response. It is plausible to assume that neonatal calves are capable of making antibodies to agents such as parainfluenza-3, BVD, bluetongue, and chlamydial organisms as long as antibodies to these agents were not present in the colostrum.

Keeping these facts in mind, some researchers are investigating the potential usefulness of in utero vaccination for the prevention of disease of the newborn. Results of in utero vaccination with E coli are encouraging and would suggest the necessity for additional studies on the feasibility of this technique. This procedure has the advantage of providing protection at birth as well as preventing the suppressive effects of colostral antibody on the immune response.

The value of parenterally administered antiserum to calves is questionable. An important aspect to consider when giving antiserum to an animal is that passively administered antibodies have a short life and also have an inhibitory effect on the production of antibodies by the host. This depression of the natural immune response is specific, long lasting and acts by reducing the number of antibody forming cells. Current research shows that it is unlikely that sufficient gamma globulins can be injected into an agammaglobulinemic calf to produce a normal level. The injection of 13 grams of gamma globulin in a single dose produces symptoms similar to anaphylaxis, and double that dosage results in death in just a few minutes.

It is quite likely that parenteral administration of antiserum may be of little or no benefit in certain respiratory and enteric diseases where local immunity, perhaps largely mediated by the IgA class of antibody, is a predominant part of the immune defense mechanism. In instances where the basis of immunologic protection may depend largely or perhaps solely on cell-mediated immunity, it is unlikely that administration of antibodies by any route would have significant effect. Our uncertainty of the basic mechanisms of immunologic protection in many diseases illustrates the need for additional basic research on the immunologic responses of cattle.

With these facts in mind a rational approach to the use of parenteral antiserum in calf scours can be formulated. The sodium sulfite test mentioned previously can be performed at the calf's side and used as an indicator of which calves should receive parenteral antiserum. A scouring calf which is agammaglobulinemic is quite susceptible to septicemia. Parenterally administered antiserum would decrease this susceptibility. A scouring calf that has a moderate to high level of gammaglobulins already has a fairly good resistance to septicemia. The dangers of anaphylaxis would outweigh the small benefit of antiserum in this case.

REFERENCES