Viral Infection of the Bovine Fetus and Its Environment

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Summary

Evidence of infection with noncytopathogenic BVD virus was detected in 5 of 147 live apparently healthy bovine fetuses collected from slaughter cows. Infection was determined by virus isolation from tissues of 3 fetuses and by the presence of neutralizing antibody in the serum of 2 others. One of the 3 fetuses with virus present had antibody also. Noncytopathogenic BVD virus was isolated from placentomes associated with 2 of 3 fetuses from which virus was isolated. Neutralizing antibody was not detected in the serum of a cow carrying an infected fetus. Antibodies to BVD virus were detected in sera from 86.9% of the dams. Although antibodies to IBR virus were detected in 67.0% and to PI-3 virus in 100.0% of sera tested from dams, no evidence of fetal infection with these viruses was found.

Factors affecting the frequency and outcome of infection of the bovine fetus were discussed in relation to 14 recognized viral entities.

1. Introduction

Fourteen viruses (4 DNA, 8 RNA, and 2 unclassified) have been reported to infect the bovine fetus or placenta or have been associated clinically with fetal death, abortion or other syndromes related to the fetal and neonatal periods (Table 1). Ten of the viruses were recovered from fetuses or newborn calves. Four of the 10 viruses also were isolated from fetal fluids and/or placental tissue. One virus that has been associated with abortion was isolated from fetal fluids only. For 3 viruses, association has been limited to abortions observed in naturally infected herds.

Adverse effects on the fetus may result directly from viral infection or indirectly through changes in placental function caused by placentitis. Generally, fetal death or gross malformations are the effects usually recognized. Inapparent infection of the fetus with very mild cellular changes can be recognized only when specialized techniques are applied. The presence of precolostral antibody to specific viruses in apparently normal newborn calves is evidence that viral infections of the fetus occur without resultant persistent abnormalities often associated with prenatal infections. The exact viral cause of many fetal anomalies may not be recognized unless exhaustive diagnostic methods are used.
With the increasing number of viruses recognized as capable of infecting the bovine fetus or placenta, it is apparent that our diagnostic methods often will be the factor limiting our ability to detect them. The purpose of this study was to determine the frequency of viral infection in a group of live bovine fetuses and their placental tissues collected in an abattoir by the use of cultural, histologic, and serologic methods.

2. Materials and Methods

Uteri from 146 pregnant cows were collected in an abattoir and transported to the laboratory as described earlier (36). The gestational ages of the 147 fetuses which they contained were estimated by their weights, crown-rump lengths, and external features (34). Blood was collected from 122 dams and 147 fetuses by cardiac puncture. The fetuses and placental tissues were examined grossly for anomalies and other indications of disease. Samples of the fetal organs (brain, kidney, liver, lung, mesenteric and prescapular lymph node, small intestine, spleen, and thymus) and membranes were placed in formalin for histologic examination. In addition, samples of the following fetal organs were removed to prepare a tissue homogenate for culture: brain, kidney, liver, lung, and spleen. A homogenate also was prepared from a placentome from each uterus.

The homogenates were inoculated into embryonic bovine kidney (EBK) cell cultures in attempts to isolate the following viruses by methods described earlier (22, 25, 28): bovine viral diarrhea (BVD), infectious bovine rhinotracheitis (IBR), and para-influenza-3 (PI-3). Three or more serial passages in cell culture were done before these tissues were considered free of these viruses. Final cell culture passages were hemadsorbed (98) with bovine erythrocytes. Isolated viruses that were suspected to be BVD were serially passaged 3 times and then were serotyped by cross-neutralization techniques (24).

Plasmas or sera from cows and fetuses were assayed for virus neutralizing antibodies with the NADL strain of BVD virus (23) and for PI-3 antibody by the hemagglutination inhibition (HI) procedure (27). In addition, specimens were tested for the presence of IBR antibody by the following virus-neutralization procedure: To 3 tubes containing 0.5 ml of undiluted plasma, 0.5 ml of medium containing 10^2.5, 10^2.5 and 10^1.5 TCID_{50} of IBR virus were added. After 30 minutes of incubation at room temperature, 0.2 ml of each mixture was inoculated onto an EBK cell culture (28). After a 30 minute adsorption period, culture medium was added and the cultures were incubated at 37°C. All were examined during a 5-day period for CPE. Plasmas which neutralized at least 10^2.5 TCID_{50} of virus were considered to contain specific antibody.

3. Results

Evidence of disease was not detected in the fetuses and placental tissues when examined grossly or in the fetal tissues and placental tissues examined histologically.

Nonecytopathogenic BVD viruses were isolated from 3 fetal tissue homogenates and from the placentome homogenates of 2 dams (Table 2). No IBR or PI-3 viruses were detected in any of the fetal tissues or placental tissues tested.

Sera from 106 of 122 (86.9%) dams had detectable BVD antibodies (Table 3). Sixty-one of 91 (67.0%) had IBR antibodies, and all of 95 (100.0%) tested had PI-3 antibodies. Antibody to IBR was not found in any serum from 39 fetuses taken from dams with IBR antibody. Antibody to PI-3 was not detected in serum from any of 105 fetuses. Antibody to BVD was found in serum from 3 of 147 fetuses.