Prenatal Infection Following Maternal Exposure to Porcine Parvovirus on Either the Seventh or Fourteenth Day of Gestation

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ABSTRACT

Intranasal and oral exposure of two gilts to porcine parvovirus on either the seventh or 14th day of gestation resulted in prenatal infection. Normal appearing fetuses and necrotic remnants of what were believed embryos and extraembryonic membranes were found when the gilts were necropsied seven weeks after exposure. The presence of masses of porcine parvovirus antigen throughout necrotic tissues of six of seven embryos, but not in any of the nine normal appearing fetuses suggested that embryonic death was due to porcine parvovirus.

RÉSUMÉ

L'administration intra-nasale et orale du parvovirus porcin à deux truies, au septième ou au quatorzième jour de leur première gestation, provoqua une infection prénatale. L'auteur nota la présence de foetus d'aspect normal et de résidus nécrotiques qui semblaient correspondre à des embryons et à des morceaux de placenta, lors de la nécropsie des truies expérimentales, sept semaines après leur infection. La présence d'agrégats de parvovirus porcin dans les tissus nécrosés de six des sept embryons, mais dans aucun des neuf foetus d'aspect normal, permit de penser que la mortalité embryonnaire était attribuable à ce virus.

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Porcine parvovirus (PPV) is a cause of reproductive failure of swine characterized by prenatal infection and death, usually without maternal clinical signs (2,6,7,8,9, 12,17,18,21). The disease is more likely to occur if dams are infected before about the 56th day of gestation (1,9,13,19). Fetuses may not be infected transplacentally for two (15) or more (9) weeks after maternal exposure and by about 70 days of gestation they are immunocompetent for PPV (1,5,9,19). The earliest time of maternal exposure during gestation that can result in reproductive failure is less clearly defined. Joo *et al* (9) have suggested that under natural conditions reproductive failure occurs only when dams are infected during the first part of the middle third of gestation. On the other hand, Gillick (8) and Rodeffer *et al* (20) presented circumstantial evidence for infection and embryonic death during the first third of gestation and Lucas *et al* (10) found experimentally that embryos became infected when their dams were inseminated with virus-containing semen. Although reproductive failure was not confirmed in the latter study the virus may not have been fully virulent (3). Our observations of naturally occurring cases of PPV-induced reproductive failures are consistent with those of Gillick (8) and Rodeffer *et al* (20) and we have indicated that dams are at risk when infected with PPV at any time during about the first half of gestation (14). Additional support for this hypothesis is provided by a recent study of embryos and fetuses that had died due to PPV infection and were collected when their dams were slaughtered (15). However, there are no reports of experiments

confirming that maternal exposure before about the third week of gestation (13) results in reproductive failure.

The following experiment was designed to determine the sequelae of maternal exposure to PPV at seven or 14 days of gestation. Experimental animals (two gilts and two boars) were derived by hysterectomy, deprived of colostrum and kept in isolation. All were free of antibody for PPV. Gilts were bred on two consecutive days of estrus, once to each of the boars. They were exposed intranasally and orally to 1 ml ($10^{6.7}$ median cell culture infective doses) of PPV (strain NADL-8) on the seventh day (gilt 1) and 14th day (gilt 2) of gestation and were killed 49 days later on the 56th day (gilt 1) and 63rd day (gilt 2) of gestation. Sera collected from the gilts just before exposure to PPV and at the time of necropsy were tested for hemagglutination inhibiting (HI) antibody for PPV. Maternal ovaries, uterine and mandibular lymph nodes, fetal lungs and remnants of embryos and extraembryonic membranes were tested for infectious PPV and PPV antigen. Methods used to test for antibody, virus and antigen have been described (15).

Gilts remained clinically normal throughout the experiment. Sera collected at the time of exposure to PPV were free of HI antibody for the virus, whereas, sera collected at necropsy had HI titers of 1280 (gilt 1) and 640 (gilt 2). Normal appearing fetuses and necrotic remnants of what were believed to be embryos and extraembryonic membranes were found in both litters (Fig. 1). The time of prenatal death could not be determined unequivocally but the absence of any apparent skeletal development suggested that death had occurred during the first third of gestation. Virus was isolated from all necrotic remnants except one located next to a normal appearing fetus in the left uterine horn of gilt 2. All infected, necrotic tissues were laden with viral antigen (Fig. 2). This finding was consistent with results of previous studies of naturally and experimentally infected fetuses that died due to infection with PPV (11,12,13,14). Virus was also isolated from the lung of one normal appearing fetus of gilt 1 and from

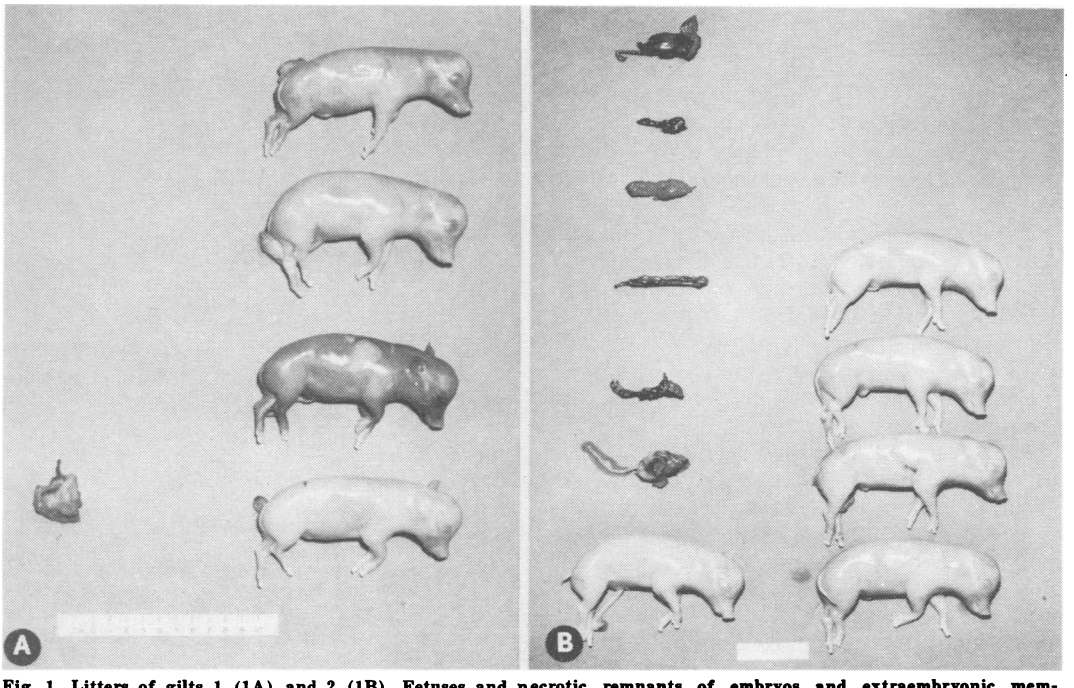

Fig. 1. Litters of gilts 1 (1A) and 2 (1B). Fetuses and necrotic remnants of embryos and extraembryonic membranes of each litter are arranged to indicate their position in the uterus. The cervical end of the uterus is at the bottom of the picture and the left (L) and right (R) horns are on the left and right, respectively. Individuals are numbered sequentially (1....x) from bottom to top for each horn. All necrotic tissue was laden with viral antigen except L2 of gilt 4.

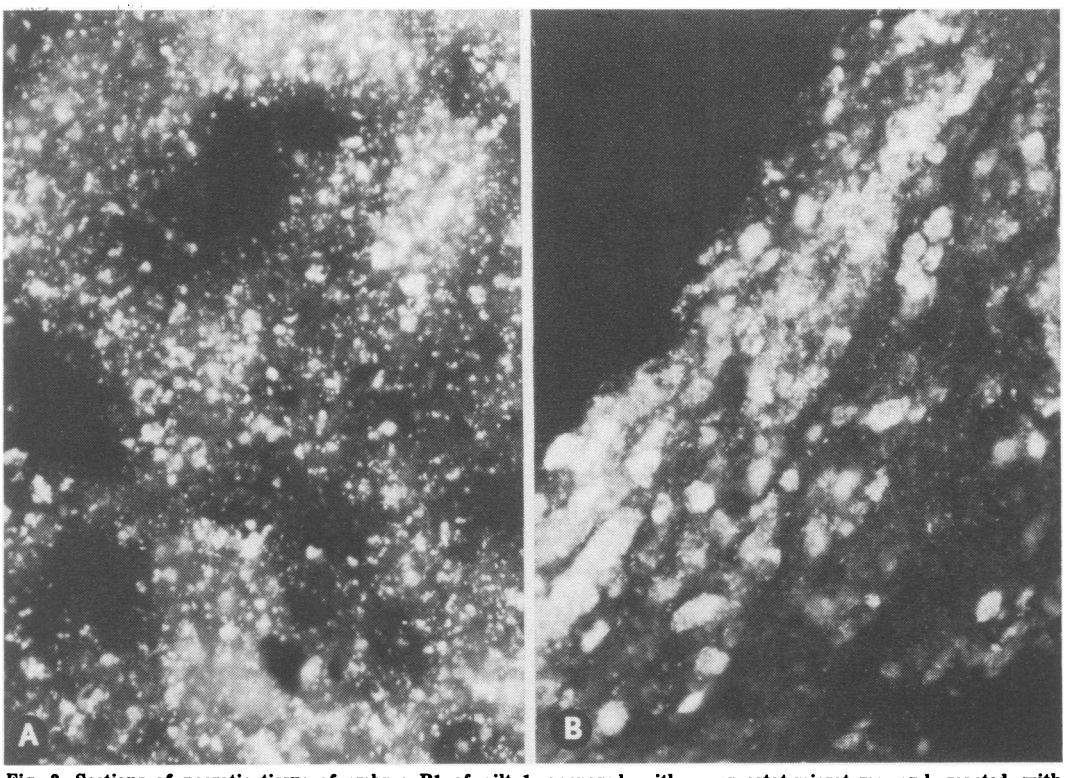

Fig. 2. Sections of necrotic tissue of embryo R1 of gilt 1 prepared with a cryostat-microtome and reacted with fluorescent antibodies for porcine parvovirus. x400.

the mandibular lymph node of the same gilt. Viral antigen was not detected in these tissues. Neither virus nor antigen was detected in any of the other tissues tested.

Results indicate that prenatal infection can follow oral and intranasal exposure of gilts to PPV on either the seventh or 14th day of gestation. The finding of masses of PPV antigen throughout necrotic tissues of six of seven embryos but not in any of the live, normal appearing fetuses suggests that embryonic death was due to PPV (11,12,13,14,15). Several studies (5,11,12, 13) have revealed that PPV usually replicates extensively before death of the prenatal pig. Because live fetuses were near the age of immunocompetence (1,5,9, 19) for PPV, they probably would have survived *in utero* even if they subsequently had been infected by intrauterine spread of the virus. A reduction of litter size due to PPV infection early in gestation was suggested previously by the finding of necrotic remnants of placental tissues in small litters ($\leq$4 live fetuses) that had antibody for PPV (4).

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