Porcine epidemic diarrhoea (PED) is a highly infectious coronavirus disease of pigs, caused by porcine epidemic diarrhoea virus (PEDV). Emerging strains associated with severe disease have been recognised in east and southeast Asia and have recently been identified in the US. PED causes profuse, watery diarrhoea in pigs of all ages. High mortality (up to 100 percent) may be seen in young pigs whereas the disease tends to be less severe in older animals, with a mortality rate of only 1–3 percent. Infection has been associated with significant losses in pre-weaning and growing pigs, with overall morbidity and mortality in affected herds ranging from 30 to 100 percent. If you suspect PED you should call the free exotic pest and disease hotline, 0800 80 99 66.

New Zealand and overseas status

PEDV is an Alphacoronavirus in the Coronaviridae family, and is closely related to human coronavirus (HCoV). PED was probably first recognised in England in 1971, but the cause was not established until 1978 when outbreaks were reported in Belgium and the UK (Popischil et al., 2002; de Groot et al., 2012). Since then the disease has been described throughout much of the world but has not been identified in either Australia or New Zealand. Significant outbreaks of PED were described in Korea in the 1990s that subsequently spread across east and southeast Asia. New PED strains subsequently emerged in China and spread to Vietnam and Thailand. In late 2010, despite vaccination, more than a million piglets died in China following infection with PEDV; the mortality rate in infected piglets was reported to be 80–100 percent (Sun et al., 2012; Williamson et al., 2013).

In May 2013 a PED virus very similar to the highly virulent strains currently circulating in Asia was detected in the US. The virus is causing severe PED outbreaks in 15 states including pig-dense areas of Iowa, Colorado, Indiana, Illinois, North Carolina and Minnesota. Infection has been associated with significant losses in pre-weaning and growing pigs, with morbidity and mortality in affected herds ranging from 30 to 100 percent (USDA, 2013).

Transmission

PED is primarily thought to be transmitted through the faecal-oral route by contact with live infected pigs, pig faeces or manure and contaminated vehicles or fomites, including feed. However, the rapid long-distance spread of the virus between epidemiologically unrelated farms has created some concern that other modes of spread, including airborne transmission, may be important (Pensaert, 2006).

The source of PED introduction into the US is not yet known. It has been suggested that it entered through the movement of infected pigs from Canada, but no cases of PEDV have ever been confirmed in Canada. PEDV isolated in the US has been shown to be 99.4 percent similar to virus from severe Chinese outbreaks, and the outbreaks have been similar clinically to those seen across east Asia. This suggests the infection is most likely a result of introduction of the virus from that region. Some efforts have been made jointly between the pig industry and the US Department of Agriculture to investigate the possibility that contaminated feed from China has been a transmission pathway (Roberts & Middlemiss, 2013).

Pathogenesis

PEDV replicates in the cytoplasm of villous epithelial cells throughout the small intestine and colon, resulting in villous stunting in the small intestine similar to that described following infection with transmissible gastroenteritis virus (TGEV) (Popischil et al., 2002). Studies to date have not shown viral replication in cells outside the intestinal tract (de Groot et al., 2012).

Presentation

The main clinical sign associated with infection is profuse watery diarrhoea, which may affect all ages. Piglets less than two weeks old may die from dehydration after three to four days and an average mortality rate in this age group of 50 percent is described although it may be much higher, especially with emerging strains of PEDV that have been seen in Asia and North America. Abdominal pain may be seen in older pigs and although morbidity is likely to be high, a mortality rate of only 1–3 percent has been described (Roberts & Middlemass, 2013). Infection with PEDV causes clinical signs comparable to TGEV (also a Coronavirus). Outbreaks of diarrhoea caused by infection with TGEV occur in pigs of all ages. Older animals generally recover within a week, while mortality in piglets less than seven days old is around
50 percent and may approach 100 percent. Morbidity may be close to 100 percent in naïve herds. Upon introduction to a farm TGEV spreads rapidly, often with nearly all pigs becoming infected in the first one to two weeks. The disease is more likely to become endemic on larger farms, on farms that have frequent or high numbers of incoming stock movements, or where ineffective control measures are implemented (The Pig Site 2013; Pensaert, 2013).

**Diagnosis**

PED diagnosis cannot be made on clinical signs alone. Direct immunofluorescence or immunohistochemical tests can detect viral antigen in sections of small intestine from acutely infected individuals, but loss of enterocytes limits the use of these tests in pigs that have died as a result of infection. Electron microscopy can be used to demonstrate the presence of PEDV particles in the faeces of infected pigs, but this will not distinguish PEDV from TGEV as both viruses have the same morphology (Popischil et al., 2002). ELISA tests have been developed to detect PEDV antigens in faeces of infected individuals and also to detect specific antibodies in serum. Viral antigen can be detected in faeces 3–11 days after infection and serum antibodies appear seven days after infection. RT-PCR and in situ hybridisation tests have also been described (Pensaert, 2006).

**Prevention and control**

Most growing pigs recover from infection without treatment unless secondary infections occur. Infection in suckling pigs is almost always fatal unless the piglets are borne to immune dams that have survived prior PED infection and can supply ample protective antibodies through colostrum. Most control strategies take advantage of this by ensuring pregnant sows are rapidly infected (during the acute phase of an outbreak) before they farrow (Pensaert, 2006).

In the face of an outbreak of PED in an industry or area, high standards of biosecurity are required to prevent the introduction of infection onto susceptible farms. Once infected, a farm should be strictly quarantined and managed in such a way as to minimise the likelihood of further spreading the infection. On endemically infected farms, use of “all-in, all-out” practices is important to break the transmission cycle between actively infected pigs and younger, naïve animals (USDA, 2013).

Attenuated vaccines have been developed in South Korea, Japan and China but none are reliably efficacious in preventing infection or reducing the severity of clinical signs that result from infection with the prototype or newly emerged strains of PED. Similarly, vaccines against TGEV also have very limited efficacy.

**References**


Eric J Neumann  
Senior Lecturer in Medicine and Epidemiology  
Massey University EpiCentre  
Wool Building  
University Avenue  
Palmerston North  
E.neumann@massey.ac.nz

Naya Brangenberg  
Incursion Investigator  
Investigation and Diagnostic Centre  
Ministry for Primary Industries  
66 Ward Street  
Upper Hutt, Wallaceville  
Naya.brangenberg@mpi.govt.nz
Stephen Cobb
Acting Manager, Risk Analysis (Animals and Aquatic)
Ministry for Primary Industries
25 The Terrace
Pastoral House
Wellington
Stephen.cobb@mpi.govt.nz