Viral enteritis in domestic animals

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Viral enteritis is a major cause of morbidity and mortality in neonatal domestic animals, but the most significant pathogens responsible vary considerably between animal species. The viral pathogens currently recognised as significant concerns in animal health were all identified over 20 years ago, and there has been limited recent investigation of the aetiology of viral enteritis in domestic animals using newer pathogen discovery techniques. While effective vaccines are available to control some of these enteric pathogens in some animal species, comprehensive and specific control measures for viral enteritis are lacking in most domestic species. Further research is needed to identify all the major viral pathogens responsible and to develop vaccines to facilitate more effective control.

Enteritis is probably the most common life-threatening neonatal disease encountered by our major domestic mammalian species. The pathogens responsible include viruses, bacteria and protists, but viral agents are the most significant of these in most animal species. Patterns of disease caused by viral enteric pathogens are strongly influenced by the endemicity of the virus in animal populations, by variations in age susceptibility and by the systems used to manage groups of animals. As most domestic animals are reared in groups, with limited opportunity to ensure ideal hygiene standards, there is constant opportunity for faecal–oral transmission of pathogens, so many of the viral pathogens are endemic in most populations. As a result, most dams secrete significant quantities of neutralising antibody against most of the viral pathogens in their colostrum and milk, and one of the major influences on the occurrence of viral enteritides is the age of weaning. Animals reared in management systems that allow late weaning are less likely to suffer from viral enteritis, as they are exposed to, and develop protective antibody against, most of the endemic viral pathogens they will encounter while still under the protection of the colostrum and milk antibody they are ingesting. In contrast, animals that are weaned early, particularly calves in dairy operations and piglets in segregated early weaning programs, which are used to generate stock free of some bacterial pathogens, are at much greater risk.

The most significant viral pathogens vary greatly with the species. While rotaviruses can cause significant disease in most species, the rotaviruses responsible appear to be distinct for each species, with little evidence of cross-species transmission. There are also distinct enteric coronaviruses in most species, of varying significance as causes of diarrhoea, as well as a range of other enteric viruses that have more significance in particular species. While there are highly effective vaccines available to control disease caused by some of these viruses, in other cases either vaccines are not available, or they are of limited or unproven efficacy. This brief review will highlight the most significant viral causes of diarrhoea in each of the major domestic species and the availability of effective vaccines to control them. We have not included viral pathogens that cause multisystemic disease in which diarrhoea may be one manifestation.

Foals

The most prevalent viral pathogens identified in the faeces of foals with diarrhoea are Group A equine rotaviruses. Surveys report that 20–77% of cases of foal diarrhoea are associated with these viruses and they appear to be endemic in most, if not all, horse populations[1-4]. The most prevalent serotypes are G3P[12] and G14P[12] in all populations studied. The significance of other viral pathogens in foals has generally not been assessed, although an equine enteric coronavirus has been identified[5], and it has been suggested that Berne virus, an equine torovirus, may cause diarrhoea[6]. A vaccine, administered to dams to increase concentrations of neutralising antibody in colostrum and milk, is available in some countries. While it has been shown in experimental studies that vaccination will increase milk antibodies against equine rotaviruses, published studies of the one commercialised vaccine have not demonstrated its efficacy in preventing diarrhoea[7,8].

Calves

Group A bovine rotaviruses have been found to be the most significant cause of neonatal diarrhoea in calves in many countries, and, as with equine rotaviruses, they appear to be endemic in most populations[9,10]. The dominant G and P serotypes are G6 and G10, and P[1], P[5], and P[11], with similar relative prevalences of the serotypes seen in most studies[11-13]. Group B and C rotaviruses have been identified at low prevalences in some studies[14,15]. Bovine coronaviruses have generally been identified as the next most significant cause of neonatal diarrhoea in calves[9,10], although the disease they cause generally appears to be more severe than that caused by bovine rotaviruses, reflecting observations from experimental studies showing that bovine coronaviruses infect a larger proportion of the villous epithelium than bovine rotaviruses[16].

There are fewer surveys of the relative prevalences of other enteric viruses in cases of diarrhoea in calves, but bovine toroviruses, genotype 1 and 2 bovine noroviruses and bovine neboviruses have each been detected in the faeces of approximately 5–36%[17], 8–80%[18-20], and 7–28%[21,22] of diarrhoeic calves, respectively. In most surveys, noroviruses are only detected in conjunction with other enteric pathogens.

Maternal vaccination against rotavirus and coronavirus is used in a number of countries to enhance passive immunity in calves, resulting in a reduction in the incidence of infection with these pathogens, and the clinical duration and severity of disease[23-25].

Lambs

There have been limited studies of viral enteritis in lambs, but Group A and Group B rotaviruses have been detected in cases of diarrhoea[26]. Of the limited number of group A ovine rotaviruses serotyped, 5 G types and 6 P genotypes have been found in the following combinations, G3P[1], G6P[11], G8P[1], G8P[14], G9 P[8] and G10P[15] [27-29].

Piglets

Internationally, the major cause of severe gastroenteritis in piglets is the coronavirus transmissible gastroenteritis virus (TGEV), but this pathogen is exotic to a number of countries, including Australia. Where TGEV is not endemic, Group A porcine rotaviruses are the most significant viral contributors to the burden of diarrhoeal disease in piglets[30]. Many serotypes have been detected in pigs, but the most common are G3P[7], G4P[6], and G5P[7][31-33]. Viral pathogens with lower prevalences include Group B and C rotaviruses[34], porcine noroviruses and porcine sapoviruses. Porcine epidemic diarrhoea virus, a coronavirus that is exotic to Australia, causes disease in older pigs. Porcine sapoviruses have been detected at prevalences of 6–62%, although some studies have failed to find a difference in prevalence between diarrhoeic and healthy piglets[35,36].

Commercial vaccines, available in some countries, help control the disease caused by TGEV and porcine rotaviruses by reducing morbidity and clinical severity; however, research continues for more efficacious vaccines[37-39].

The severity of disease caused by TGEV appears to have decreased where porcine respiratory coronavirus, a naturally occurring deletion mutant of TGEV that only infects the respiratory tract mucosa, has become endemic[40,41].

Puppies

The most significant cause of diarrhoea in young dogs is canine parvovirus. While infection causes systemic disease, characterised by panleukopaenia, and myocarditis in very young puppies, the principal clinical manifestation is the severe, haemorrhagic diarrhoea that results from infection of the immature intestinal crypt cells. Canine coronavirus infection is widespread and generally considered of minimal clinical significance, but more severe disease has been reported in dogs infected with a virulent pantrophic variant and in animals with mixed viral infections[42,43].

A limited number of canine rotaviruses, associated with mild enteric disease, have also been detected and all that have been characterised have been found to be G3P[3][44-46]. The attenuated vaccines available to control canine parvovirus are very effective. A number of vaccines with variable efficacy are available for coronavirus, but there is some controversy over their use[47].

Kittens

Diarrhoea is not regarded to be a major clinical problem in kittens, although parvoviruses such as feline panleukopaenia virus and canine parvovirus[48] can cause diarrhoea in felids. Feline enteric coronaviruses are prevalent, but clinical disease is usually mild or absent. A limited number of feline rotaviruses have been detected, and have been found to belong to serotypes G3P[3] and G3P[9][44,46]. As with dogs, the attenuated feline panleukopaenia vaccines are very effective in preventing clinical disease[49].

Conclusion

With the advent of more recent molecular detection methods, new enteric viruses are being increasingly discovered and genetically characterised, aiding development of better diagnostic techniques and potentially more effective vaccines. However, many groups of viruses are yet to be comprehensively investigated in a number of species, and the precise pathogenic significance of others is still to be determined.

Production of effective vaccines to control enteritis in young animals remains a challenge. This is in part a reflection of the limited understanding we have of the most important pathogens in many species. In addition, inactivated vaccines are ineffective in inducing active immunity in the intestine of naïve animals, while live attenuated vaccines often have reduced immunogenicity compared to virulent strains of the virus, and are often inactivated by maternally derived immunoglobulins when administered to neonates. The most effective vaccines have often been inactivated, parenterally delivered vaccines administered to dams to enhance levels of lactogenic immunity. The principal advantage of these vaccines is that the difficulties associated with inducing active immunity in neonates are avoided. Their disadvantage is that the immunity they confer is generally only partially protective and ceases completely at weaning. There appears to be considerable scope for the future development and application of vectored vaccines to induce active immunity in neonates and thus improve control of this important group of animal pathogens.

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